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PHYSICS ABSTRACTS

SECTION A

of

SCIENCE ABSTRACTS

SECTION A, PHYSICS

SECTION B, ELECTRICAL ENGINEERING

Edited and Issued Monthly by

THE INSTITUTION OF ELECTRICAL ENGINEERS

In Association with

THE PHYSICAL SOCIETY

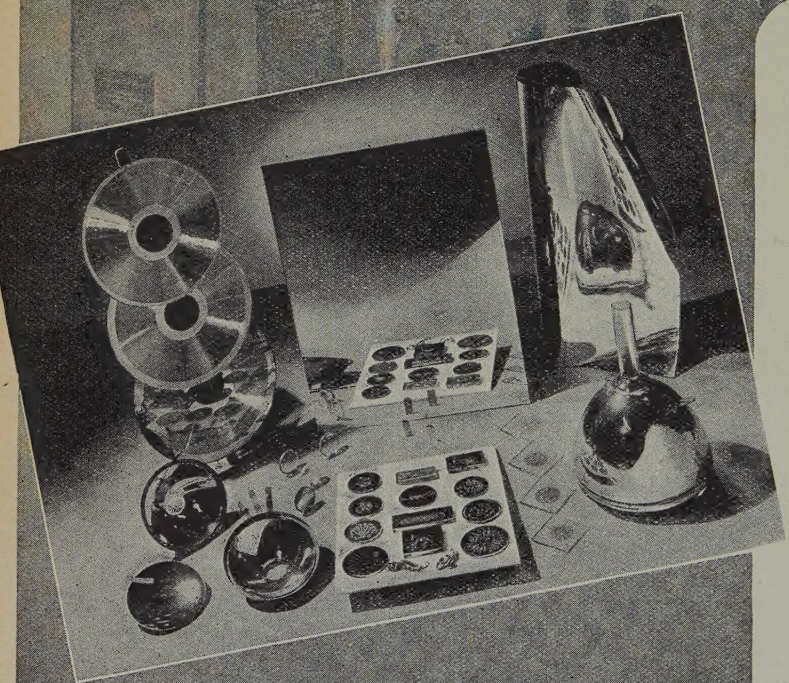
THE AMERICAN PHYSICAL SOCIETY

THE AMERICAN
INSTITUTE OF ELECTRICAL ENGINEERS

ABSTRACTS 3682–4592

VOLUME 53 **JUNE 1950** NUMBER 630

VACUUM COATING



Coating by high vacuum has r
developed into a routine product
process in the optical, electrical
plastic jewellery industries. Some
the fascinating applications illustra
include:—

(1) **Cellulose acetate record mas
gold sputtered prior to elec
copying.**

(2) **Aluminised plain and spher
mirrors for television with si
protection.**

(3) **Aluminised car reflectors on pla
base.**

(4) **Evaporated resistors for hi
frequency radio work.**

(5) **Anti-reflection coatings on opt
elements.**

(6) **Aluminised prisms for opt
instruments.**

(7) **Aluminised plastic jewellery
mouldings with aluminium, v
back-reflecting surface.**

(8) **Multiple-beam interference fil
used as beam splitters in opt
instruments.**

(9) **Aluminised fluorescent screen
cathode ray tube.**

(10) **Aluminised cellulose acetate sh
for decorative purposes.**

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RELATED SUBJECTS CONTAINED IN SECTION B (ELECTRICAL ENGINEERING ABSTRACTS)

Mechanical testing
Non-destructive testing
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Electrical and magnetic measurements
and instruments
Electronic relays and counters
Automatic control mechanisms
Applied electrochemistry
Photocells
Thermionic tubes
Cathode-ray tubes
X-ray tubes
Amplifiers
Radiocommunication
Mechanical engineering
Illumination
Metallurgy

LIST OF JOURNALS

The following list supplements that published with the Index Number of Vol. 53 (1950). Journals marked * are not received regularly though abstracts of articles from them are occasionally published. The addresses given are believed to be correct, but no responsibility can be accepted for errors.

Abh. Dtsch. Akad. Wiss. Berlin, Math.-nat. Kl.	*Abhandlungen der Deutschen Akademie der Wissenschaften zu Berlin. Mathematischnaturwissenschaftliche Klasse.* Unter den Linden 9, Berlin, N.W.7.
Ann. Acad. Sci. Fennicae, Ser. A II.	*Annales Academiae Scientiarum Fennicae, Series A II. Chemica.* Helsingfors.
**Ann. Géophys.*	*Annales de Géophysique.* 165 Rue de Sèvres, Paris (XV^e).
Astr. J.	*Astronomical Journal.* Yale University Observatory, New Haven 11, Connecticut. [Change of address.]
Automat. Elect. Tech. J.	*Automatic Electric Technical Journal.* 1033 West Van Buren Street, Chicago 7, Illinois.
Brüel and Kjær Tech. Rev.	*Brüel and Kjær Technical Review.* Nærum, Denmark.
Elektrotechnik, Prague.	*Elektrotechnik.* Vocelova 3, Prague XII.
Istanbul Univ. Obs. Yaz.	*Istanbul Universite Observatuari Yazilari.* [Publications of the Istanbul University Observatory.] Istanbul, Turkey.
J. Mech. Lab., Tokyo.	*Journal of the Mechanical Laboratory.* The Government Mechanical Laboratory, The Agency of Industrial Science and Technology, Tokyo.
J. Roy. Tech. Coll., Glasgow.	*Journal of the Royal Technical College, Glasgow.* Glasgow.
Przegl. Telekomun.	*Przeglad Telekomunikacyjny.* Nowogrodzka 45, Warsaw III p.
Rev. Chim. Pura Appl.	*Revista de Chimica Pura e Applicada.* Laboratorio Ferreira da Silva, Faculdade de Ciencias, Porto.
Rev. Tech. Luxemb.	*Revue Technique Luxembourgeoise.* L'Association Luxembourgeoise des Ingenieurs et Industriels. 13 Place d'Armes, Luxembourg.
S.B. Dtsch. Akad. Wiss. Berlin., Math.-nat. Kl.	*Sitzungsberichte der Deutschen Akademie der Wissenschaften zu Berlin. Mathematisch-naturwissenschaftliche Klasse.* Unter den Linden 9, Berlin, N.W.7.
**Soc. Sci. Lodz, Sect. III.*	*Societas Scientiarum Lodziensis, Sectio III.* Lodz.

ORIGINAL ARTICLES

It is regretted that the articles from which abstracts are made cannot be sent out on loan. Application should be made to appropriate lending libraries or to the publisher of the Journal concerned; publishers' addresses, where known, are given in the "List of Journals" published with the January Number of Vol. 53 (1950), or in the supplementary lists published subsequently.

ERRATA, 1950

Abstr. 1373, line 3: *for* G. E. Bielovitsky and L. V. Suchov *read* L. V. Sukhov and G. E. Belovitskiĭ.

Abstr. 2542, line 3: *for* S. I. Vernov *read* S. N. Vernov.

Abstr. 2582, line 3: *for* Ya. S. Schur *read* Ya. S. Shur.

Abstr. 2647, line 10: *for* "element 61" *read* "$_{61}$Pm"; line 13 *for* "Pr" *read* "Pm".

ERRATA, 1949

Abstr. 1632, line 2: *for* $\mathbf{a_0 \cos 4x}$ *read* $\mathbf{a_2 \cos 4x}$.

Publications

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VOLUME XIII. Published July 1950, contents as follows:

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L. GOLDBERG	*Recent advances in Infra-Red Solar Spectroscopy*
W. G. PENNEY and H. H. M. PIKE	*Shock Waves and the Propagation of Finite Pulses in Fluids*
E. C. STONER	*Ferromagnetism: Magnetization Curves*
M. RYLE	*Radio Astronomy*
G. P. KUIPER	*Planetary and Satellite Atmospheres*
A. H. COOKE	*Paramagnetic Relaxation Effects*
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THE PHYSICAL SOCIETY

1 LOWTHER GARDENS, PRINCE CONSORT ROAD, LONDON, S.W.7

MATHEMATICS 51

512.2

582. An application of the method of steepest escents to the solution of systems of non-linear multaneous equations. A. D. BOOTH. *Quart. J. lech. Appl. Math.*, **2**, 460–8 (*Dec.*, 1949).

516 : 535.31

Non-euclidean geometry and geometrical optics. II. *See Abstr.* 3896

517.42 : 530.12

Relativity theory as a stimulus in mathematical search. *See Abstr.* 3746

517.63

583. The summation of Fourier series by operational ethods. L. A. PIPES. *J. Appl. Phys.*, **21**, 298–301 *pril*, 1950).

A method for the summation of certain types of ourier series by the use of Laplace transforms is esented. Graphical representations of functions fined by Fourier series can be easily obtained in any cases of practical importance. A.

517.65 : 523.877

The logarithms of the generalised exponential tegrals. *See Abstr.* 3733

517.941

584. A note on the numerical integration of ferential equations. W. E. MILNE. *J. Res. Nat. r. Stand., Wash.*, **43**, 537–42 (*Dec.*, 1949).

A method is developed, in which the approximation rmulae contain derivatives of higher order than ose contained in the differential equation itself. he method is particularly useful for linear differential uations. Numerical examples are given for ssel's equation. A.

518.5

585. Programming a computer for playing chess. E. SHANNON. *Phil. Mag.*, **41**, 256–75 (*March*, 1950).

518.5

586. Giant brains. E. C. BERKELEY. *New York, hn Wiley and Sons*; *London, Chapman and Hall* 949) xvi + 270 *pp.*, 80 *figs.*

The principles of coding information, and the nary system of notation, are discussed and the rious types of punched-card machines described. apters are then devoted to each of the following presentative calculators: the M.I.T. differential alyser, the Harvard I.B.M. automatic sequence-ntrolled calculator, the ENIAC, the Bell Labora-ies' general-purpose relay calculator and the lin–Burkhart logical-truth calculator. The opera-ns of all are fully described, but without circuit or nstructional details. Future designs are men-ned, including such possibilities as automatic nslators, typists and information machines. Some the social implications of the robot are touched on. There is a list of more than 250 references. e book is intended to be understandable by non-cialists.

518.5 : 512.34 : 621.317.39

3687. The electronic isograph for roots of polynomials. B. O. MARSHALL, JR. *J. Appl. Phys.*, **21**, 307–12 (*April*, 1950).

An electronic apparatus which assists in the finding of the roots of polynomials is described. The device accepts the coefficients of polynomials of degree 10 or less and yields the absolute magnitude of the roots to a precision of 0·01 relative to the largest coefficient in the polynomial and an angular accuracy of 0.3 degree on the angle of the root. The method used is the electronic analogue of the expression $\omega = \Sigma a_n z^n = \Sigma a_n r^n \cos n\theta + j\Sigma a_n r^n \sin n\theta$. $\sin n\theta$ and $\cos n\theta$ are generated by a motor-driven commutator. The radius r is controlled manually. Hence a plot of ω is placed on the oscilloscope for a fixed r as a function of θ. To find the root, r is manipulated until ω crosses the origin in the ω-plane. The value of θ is found by inserting a pip on the intensity of the oscilloscope under a variable phase control. When this pip is moved to the origin of the ω-plane the phase meter indicates the angle of the root in the z plane. A.

518.5 : 621.318.572

3688. Electrical computing apparatus for equations of higher degree. H. GLUBRECHT. *Z. angew. Phys.*, **2** (*No.* 1) 1–8 (1950) *In German.*

Describes an electronic analogue computer which combines the principles of the Tischner and Rasch circuits. The given polynomial $\omega = \Sigma a_n z^n$ is transformed by the substitution $z = re^{i\omega t}$ and each term is divided into sin and cos components. These components are synthesized from a fundamental frequency signal ($\omega/2\pi = 5$ kc/s) by means of a square-law valve and a succession of 2-grid linear modulator valves, the a_n being set up on associated potentiometers. The summed sin and cos components are applied to the y- and x-plates of a c.r.t., which thus displays the ω-plane as r is amplitude modulated (at 1 c/s). A mask and photocell, or a special c.r.t., gives an output only whenever $\omega = 0$, and causes a further c.r.t. to display the corresponding amplitude and phase of z. An arbitrary curve cut in the mask in the ω-plane could similarly be transformed to the z-plane. F. F. ROBERTS

518.5 : 621.318.572

3689. Use of the relay digital computer. E. G. ANDREWS AND H. W. BODE. *Elect. Engng, N.Y.*, **69**, 158–65 (*Feb.*, 1950).

A discussion of the use of the Bell Laboratory model V computer for various mathematical problems.

518.5 : 621.385.832 : 621.318.572

3690. An electronic differential analyzer. A. B. MACNEE. *Proc. Inst. Radio Engrs*, **37**, 1315–24 (*Nov.*, 1949).

An electronic differential analyser is described, capable of solving ordinary differential equations of orders through the sixth, both linear and nonlinear, and with either constant or variable coefficients.

This analyser has a high speed of operation and is extremely flexible with regard to equation parameters and initial conditions. The flexibility permits rapid investigation of wide ranges of equation solutions with regard to periodicity, instability and discontinuities. It renders practicable the solution of end-point boundary-value problems. Two new computing elements, an electronic function generator and an electronic multiplier, are employed. A diode clamping circuit permits the use of a.c.-coupled amplifiers. A number of representative differenti equations of the linear and non-linear types ha been solved. Comparison of observed and calculate solutions reveals an accuracy of from 1–5%, whi the precision (or repeatability) of the solutions 0·002–0·1%. The errors introduced into th differential-equation solutions by the frequenc limitations of the integrators and adders, we analysed, and the results of this analysis verifie experimentally.

ASTRONOMY . ASTROPHYSICS . GEODESY 52

521.11 : 523.11

3691. The connection between dynamical cosmology and stellar dynamics. R. KURTH. *Z. Astrophys.*, **26** (*No.* 2–3) 272–8 (1949) *In German.*

Hydrodynamical equations for nebular velocity distribution and density can be deduced from the dynamical equations for a non-stationary star system with a spherically symmetric velocity distribution.

R. A NEWING

521.5 : 530.12

3692. Relativity effects in planetary motion. G. M. CLEMENCE. *Proc. Amer. Phil. Soc.*, **93** (*No.* 7) 532–4 (1949).

The precision with which the effects can be observed for different planets is discussed. Discrepancies between calculated and observed motions of perihelia and nodes might be used to establish an inertial frame of reference. Illustrative calculations of the general precession are made using only data for Earth and Mercury, and a determination of the mass of Mercury is regarded as more reliable than any previous one.

R. A. NEWING

522.2 : 535.833

The theory of two new astronomical telescopes of the Schmidt type. *See Abstr.* 4007

522.6

3693. Stellar photometry with a rotating sector. D. A. MACRAE. *Mon. Not. Roy. Astr. Soc.*, **109** (*No.* 5) 557–61 (1949).

It was found, in agreement with laboratory investigations, that, if the frequency of interruption is sufficiently high, interposing a sector is photographically equivalent to reducing the light intensity by the amount corresponding to the geometry of the sector. A.

523.112

3694. The steady-state theory of the expanding universe. W. H. MCCREA. *Endeavour*, **9**, 3–10 (*Jan.*, 1950).

A brief historical review of cosmological theories, followed by a short account of the above theory [Abstr. 3674 (1949)]. The achievements of this theory are pointed out, and some of the quantitative factors tabulated.

523.112 : 530.12

3695. On the present state of relativistic cosmology. H. P. ROBERTSON. *Proc. Amer. Phil. Soc.*, **93** (*No.* 7) 527–31 (1949).

The possibility is examined of deriving a unique cosmological model from observational data, an Hubble's model is examined in detail. R. A. NEWIN

523

3696. The origin and evolution of the solar system K. E. EDGEWORTH. *Mon. Not. Roy. Astr. Soc.*, **10** (*No.* 5) 600–9 (1949).

It is inferred that the material which now forms th planets and their satellites existed at one time in th form of a vast rotating disc. Bodies of planetary mas cannot be formed by condensation in a cloud of ga and small solid particles must have been the chie ingredient in this primitive material. The angula momentum of the disc is explained by the assumptio that the material was collected from interstella space, which gives a result numerically of the righ order. Condensations would form in the rotatin disc, and in the first instance these would be sma and numerous. Subsequently they would coalesce t form a single large cluster in each region of inte planetary space. Each cluster would consist of nucleus and a surrounding disc or annulus. Owin to the combined effect of viscosity and tidal frictio there would be a loss of angular momentum and th bulk of the material would be absorbed by the nucle to form the planet. The residue of material in th annulus would condense to form the satellites. In th region which lies immediately inside Jupiter's orb the perturbations caused by the planet would dri much of the material inwards towards the sun. I the attenuated residue the condensations would b smaller and more numerous than usual; they wou coalesce to some extent, but not sufficiently to form single planet, and the result would be the formatio of the asteroids. In the region outside the orbit Neptune the material would also be highly attenuate and here again condensations would be small a numerous, but the progress of evolution was slowe and the region is probably populated by a very lar number of small clusters. Wandering clusters ma their appearance from time to time as comets.

523.

3697. Problems arising from the photometry of lun eclipses. F. LINK. "*Relations between Solar a Terrestrial Phenomena*," *Sixth Report. I.C.S.U.* (194 174–5. *In French.*

On several occasions the results of eclipse phot metry of the penumbral shadow have indicated excess of observed brightness over that expected fr theory amounting to 0·5 mag. It is suggest tentatively that this is caused by a luminescence of t

lunar surface under the action of solar u.v. and corpuscular rays. Some support that such an effect may occur is given by the significant correlation found between total lunar brightness, and solar constant (a change of 1% for the latter producing a variation about 30 times greater in the former), and also the fact that the ratio: spectral intensity fluctuation/solar constant may exceed 6 : 1 for wavelengths < 3000 Å. D. R. BARBER

523.53

3698. The Geminid meteor shower. M. PLAVEC. Letter in *Nature, Lond.*, **165**, 362–3 (*March* 4, 1950).

From Whipple's elements [*Proc. Amer. Phil. Soc.*, **91** (*No.* 2) 189 (1947)] secular perturbations due to Jupiter and the earth are calculated, the latter proving negligible with respect to the former. The orbit rotates rapidly around the line of apsides, the direction of which remains nearly constant. The rapid retrogression of the node causes the date of maximum to be 1 d earlier every 60 yr. A table gives the change in the least distance from the earth, the appearance of the shower apparently being limited to the time-range A.D. 1700–A.D. 2100. It is suggested that the Geminids were separated from a parabolic comet by the close approach to the sun. M. W. OVENDEN

523.58 : 551.510.3

3699. Photographic meteor phenomena and theory; meteor photometry, fundamental equations and constants, durations and flares. L. G. JACCHIA. *Harv. Coll. Obs. Center Anal. Mass. Inst. Techn. Tech. Rep.* (*No.* 3) 36 *pp.* (1949).

The method of meteor photometry by comparison with stellar trails on unguided plates is described, with an analysis of sources of error. The luminosity, height, velocity and mass of a meteor at any point of its path can be obtained from a set of 4 simultaneous equations involving 3 separate constants. The solution of these equations with the determination of the constants from observed decelerations and light-curves is discussed; it is found that the luminous efficiency decreases with decreasing velocity. A formula is derived for the duration of a meteor of given initial mass, velocity and angle of incidence. Observed deviations from this formula are statistically correlated with the number and duration of flares in the light-curve, believed to represent the sudden loss of mass by a breaking-up process. A statistical analysis of frequency, position in trail, magnitude and duration of observed flares is made; no correlation of individual flares with height is found. It is suggested that anomalous increases of brightness of a character different from flares, occurring at heights of about 100 km, are due to an effect of the passage of a meteor through the *E*-layer. M. W. OVENDEN

523.58 : 551.510.3

3700. Atmospheric density profile and gradients from early parts of photographic meteor trails. L. G. JACCHIA. *Harv. Coll. Obs. Center Anal. Mass. Inst. Techn. Tech. Rep.* (*No.* 4) 12 *pp.* (1949).

Atmospheric densities computed by a method suggested in the preceding Abstr. from the magnitudes, velocities and masses of meteors near the beginnings of their trails are combined with those obtained from decelerations [Abstr. 2832 (1949)] to give a revised mean density profile which departs from the NACA standard profile [*NACA Tech. Note No.* 1200 (*January*, 1947)]. The densities derived from decelerations have the larger seasonal variations, confirming that this effect decreases with height. The observed rate of increase of brightness during the initial stages of a trail are used to compute log. density gradients which are in good agreement with the gradient given by the previously determined profile. M. W. OVENDEN

523.58 : 551.547

Meteoric exploration of the upper atmosphere. *See Abstr.* 4541

523.7

3701 The general magnetic field of the sun. J. EVERSHED. "*Relations between Solar and Terrestrial Phenomena*," *Sixth Report, I.C.S.U.* (1948) 21–4.

From a study of sensitive metallic lines in Mt. Wilson high-dispersion solar spectra doubt is thrown on the presence of a general magnetic field as great as 50 gauss. D. R. BARBER

523.7 : 537.591 : 551.5 : 550.38

Relations between solar and terrestrial phenomena. *See Abstr.* 4507

523.7 : 550.385

3702. The electromagnetic conditions in the vicinity of the sun and the earth. H. ALFVÉN. "*Relations between Solar and Terrestrial Phenomena, Sixth Report*," *I.C.S.U.* (1948) 95–100.

On the assumption that a solar equatorial magnetic field of 20 gauss exists, it is shown that the component of this field in the earth's vicinity, amounting to 2 microgauss, will cause the production of an electric field of 6 μV/cm by an ionic cloud moving earthward from the sun with velocity 0·01 that of light. This field is responsible for initiating the auroral discharge, and varying the electrostatic potential of the earth during the accompanying geomagnetic storm. The latter effect is reflected in the characteristic change in cosmic-ray intensity at such times. D. R. BARBER

523.72

3703. Solar radio-noise data for correlation with terrestrial phenomena. C. W. ALLEN. "*Relations between Solar and Terrestrial Phenomena*," *Sixth Report, I.C.S.U.* (1948) 25–7.

A limited programme for the continuous recording of "solar noise" is of great importance since it is clear that some solar-terrestrial relations will be clarified in the light of such observations. It is suggested that by operating a network of 3 world-wide stations at frequencies of 200 and 60 Mc/s, and recording both high and low intensities, this end could be achieved. D. R. BARBER

523.72

3704. Radio-frequency radiations from the sun. M. RYLE AND D. D. VONBERG. "*Relations between Solar and Terrestrial Phenomena*," *Sixth Report, I.C.S.U.* (1948) 42–7.

A technique is described which allows of a separation of solar radio radiation from radiation at the same wavelength originating in the galaxy. The results enable a distinction to be made of (i) low intensity radiation from "quiet" sun; (ii) steady enhanced radiation associated with large sunspots;

and (iii) short-lived "bursts" of high intensity. There is some evidence for a 27 d recurrence tendency for fluctuations of medium duration, with periodicities of 28, 27 and 26·3 d. The latter are probable effects of sunspots at different solar latitudes. D. R. BARBER

523.72

3705. Distribution of radiation from the undisturbed sun at a wave-length of 60 cm. H. M. STAINER. Letter in *Nature, Lond.*, **165**, 354–5 (*March* 4, 1950).

523.72 : 537.591.5

Solar influences on cosmic rays. *See Abstr.* 4185

523.72 : 538.566.3 : 621.396.11 : 621.396.812.5

3706. Solar electronic emissions, and their influence on radio transmissions. R. JOUAST. "*Relations between Solar and Terrestrial Phenomena, Sixth Report*," *I.C.S.U.* (1948) 104–7 *In French.*

It is suggested that the occurrence of long-delay radio echoes at times of magnetic storm activity is due to abnormal reflection from clouds of electrons high over the auroral zones. The existence of such clouds has been demonstrated by ionospheric measurements at Trömso during the "polar year"; and it is supposed that they are also responsible for the enhanced *D*-layer absorption at times of geomagnetic activity. Since both effects are directly influenced by solar emissions, a correlation between magnetic activity and radio transmission must exist.

D. R. BARBER

523.746

3707. On the daily variation of the magnetic field strength of sunspots. K. BRUNNCKOW AND W. GROTRIAN. *Z. Astrophysik*, **26** (*No.* 2–3) 313–24 (1949) *In German.*

The results for 5 sunspots in 1948 are discussed on the basis of observational series obtained at the Einstein-Tower in Potsdam by the methods and instrumental devices developed there by H. v. Klüber [see Abstr. 1403, 1404 (1948)]. The measurements of the Zeeman effect were exclusively restricted to the Fe-line 6 302·51 Å. The maximum error of a field strength determination is found to $\pm$ 100 gauss. Plots covering periods up to 10 hr reveal the presence of real variations of 20–30 gauss/hr (corresponding to 10^8 V). The spots chosen appeared to be inactive. Short-periodic variations are perhaps also indicated, but cannot yet be established with certainty. A. BEER

523.746

3708. Prediction of sunspot numbers. A. G. MCNISH AND J. V. LINCOLN. *Trans. Amer. Geophys. Un.*, **30**, 673–85 (*Oct.*, 1949).

A formula for predicting smoothed annual sunspot numbers is developed. A first approximation to the prediction of a future value in a cycle is the mean of all past values for that part of the cycle. This estimate can be improved by adding to the mean a correction $\propto$ the departure of earlier values of the cycle from the mean cycle. These correction factors are determined by the method of least squares. Sunspot data for 1834 through 1943 are used, and statistical reasons for rejecting data of earlier years are presented. Reliability of the method is discussed on the basis of the standard deviations of predictions made for each of the years of the 10 cycles in question, using all the prediction formulae developed. The prediction of 3-month means is also discussed. A.

523.746

3709. On projection as a possible source of apparent color in sunspots. J. C. BARTLETT, JR. *Science*, **111** 172 (*Feb.* 17, 1950).

523.752

3710. On the structure of the solar corona and chromosphere. F. HOYLE. "*Relations between Solar and Terrestrial Phenomena*," *Sixth Report, I.C.S.U.* (1948) 32–4.

An attempt is made to present a physical picture of the solar corona. The atmosphere has 4 regions: (i) Extends from the reversing layer up to 10 000 km, and radiation is here important. Maximum temperature is $\sim 10^5$ °C. (ii) Extends outwards to 130 000 km. Here radiation is not important. Temperature rises linearly with height and attains a maximum value 2×10^6 °C. (iii) Extends out to 700 000 km. Again radiation is not important under normal conditions, and temperature remains $\sim 2\times10^6$ °C. Electron density has fallen to $\sim 2\times10^6$ per cm^3, near the density of incoming H. (iv) Extends outwards from (iii), consisting of captured H only partially ionized. In regions (i), (ii) and (iii) ionization of H is effectively complete, and in (iii) the incoming material is buffered by atomic collision, hence the high temperature. The theory leads to the result that about 3×10^3 ergs per cm^3 per sec are emitted by the corona, in a steady state, as quanta with energies $>$ 300 eV. D. R. BARBER

523.755

3711. Propagation and emission of radio waves in the solar corona. G. BURKHARDT AND A. SCHLÜTER. *Z. Astrophysik*, **26** (*No.* 2–3) 295–304 (1949) *In German.*

Taking into account the refraction effects within an inhomogeneous medium, the intensity distribution over the disc of the undisturbed sun is calculated for the radiations in the wavelength-range of 5–15 m. The contributions of the various layers of the corona are discussed, as well as the differences between the travel times of a signal for the various wavelengths.

A. BEER

523.755 : 538.566.2

3712. On the absorption of radio waves in the solar corona. V. L. GINZBURG. *Astr. J. USSR*, **26** (*No.* 2) 84 (1949) *In Russian.* English Abstr. in *Astr. News Lett.* [*Harvard*] (*No.* 46).

Formulae for the absorption of radio waves in an ionized gas are discussed. They can be applied to the ionosphere, to the solar corona and to the interstellar gas. The paper contains computations of the "radiative depth" of the corona for wavelengths between 0·6 and 50 m.

523.755 : 550.385

Magnetic disturbances and solar corona. *See Abstr.* 4510

523.77

3713. Further measures of the decrease of wavelength of solar lines. J. EVERSHED. *Mon. Not. Roy. Astr. Soc.*, **109** (*No.* 5) 594–5 (1949).

Further measures have been made of the absolute wavelengths of solar lines in spectral regions where they can be compared directly with telluric lines. It is confirmed that in all the lines measured a decrease of wavelength has occurred. A.

523.77

3714. Recent exploration of the infra-red solar spectrum at the McMath–Hulbert observatory. R. R. McMath and L. Goldberg. *Proc. Amer. Phil. Soc.*, **93**, 362–72 (*Nov.* 30, 1949).

The spectrum has been recorded with high resolution from $1{\cdot}4\,\mu$ to $3{\cdot}6\,\mu$ with the aid of new instrumentation consisting of the McGregor spectrometer, 2 Cashman PbS cells and a Wilson amplifier. Broad areas of the solar spectrum are completely masked by absorption in the earth's atmosphere, but 3 relatively transparent "windows," centred approximately at $1{\cdot}6\,\mu$, $2{\cdot}2\,\mu$ and $3{\cdot}3\,\mu$, permit recording of many hundreds of previously unobserved absorption lines. The new lines originate both from atoms in the sun's outer envelope and from molecules in the atmosphere of the earth. Among the prominent telluric features of the spectrum are 8 bands of ordinary CO_2, as well as 5 that arise from the isotopic forms $C^{13}O_2^{16}$ and $C^{12}O^{16}O^{18}$. In addition, the spectrum reveals 5 bands of CH_4 and 3 of N_2O. Approximately 400 new solar lines appear on the tracings, the most intense lines being due to neutral atoms of H, Mg, Si and Fe, and the majority of them having excitation potentials > 5 V. A section of the i.r. spectrum of a small sunspot has also been recorded. Observations of solar limb darkening have been carried to an infra-red limit of $18\,\mu$. The significance of the new data in improving knowledge of the atmospheres of the sun and earth is discussed. A.

523.77

3715. The distribution of energy in the ultraviolet solar continuous spectrum. R. Michard. *C.R. Acad. Sci., Paris*, **230**, 516–17 (*Feb.* 6, 1950) *In French.*

523.774

3716. The centre-limb darkening of the sun between 6 700 and 23 000 Å. R. Peyturaux. *C.R. Acad. Sci., Paris*, **230**, 368–9 (*Jan.* 23, 1950) *In French.*

523.774

3717. On the opacity of the solar photosphere between 6 700 and 23 000 Å. R. Peyturaux. *C.R. Acad. Sci., Paris*, **230**, 517–19 (*Feb.* 6, 1950) *In French.*

523.821

3718. Photoelectric colours of stars in the galactic cluster Praesepe. Å. Wallenquist. *Ark. Astr.*, **1**, *Paper* 10, 101–8 (1949).

523.83

3719. A note on the mean square velocity in stellar statistics. S.-S. Huang. *Proc. Nat. Acad. Sci., Wash.*, **36**, 67–72 (*Feb.*, 1950).

523.83

3720. Theoretical study of stellar accelerations. H. Mineur. *C.R. Acad. Sci., Paris*, **230**, 512–13 (*Feb.* 6, 1950) *In French.*

523.832

3721. On the derivation of the law of distribution of one component of the stellar velocities from proper motions. G. Gurzadian. *Astr. J. USSR*, **26** (*No.* 3) 149 (1949) *In Russian.* Engl. Abstr. in *Astr. News Lett.* [*Harvard*] (*No.* 46).

523.841.1

3722. Remarks on the nova phenomenon. II. E. Schatzman. *Ann. Astrophys.*, **12**, 281–6 (*Oct.–Dec.*, 1949) *In French.*

[See Abstr. 4421 (1949)]. The propagation of shock waves in a star is further considered. The energy necessary for the ejection of matter could be produced by the conversion of a comparatively small amount of H into He, but the temperatures involved would be very high. Calculations of the decay of shock waves of small amplitude in the sun, show that ejection of matter would be possible only with waves of finite amplitude. R. A. Newing

523.841.37

3723. The pulsation of cepheids. I. L. E. Gurevich and A. I. Lebedinski. *Astr. J. USSR*, **26** (*No.* 2) 97 (1949) *In Russian.* Engl. Abstr. in *Astr. News Lett.* [*Harvard*] (*No.* 46).

523.842

3724. Formation of binaries. L. E. Gurevich and B. Yu. Levin. *Dokl. Akad. Nauk, SSSR*, **70** (*No.* 3) 385–8 (1950) *In Russian.*

523.854.12

3725. Selective absorption in the direction perpendicular to the galactic plane. M.-T. Martel. *Ann. Astrophys.*, **12**, 275–80 (*Oct.–Dec.*, 1949) *In French.*

Distances r are estimated from photoelectric colour excesses E_1 determined by Stebbins and Whitford ($\lambda\lambda$ 417 and 471 mμ), assuming (following Stebbins) that the visual absorption is 7 times the selective absorption for these wavelengths, for 53 nearby B-type stars ($r < 2\,000$ parsecs) whose distance from the galactic plane is > 250 parsecs. If the selective absorption perpendicular to the galactic plane depends only upon this distance, a linear relation between E_1 and cosec b (where b = galactic latitude) should hold, with slope B = total selective absorption in the direction of the galactic pole. 31 northern stars yield a mean square value of $B = 0{\cdot}015 \pm 0{\cdot}004$ mag., but no significant result could be obtained from the 22 southern stars. Comparison is made with previous results from observations of nebulae and globular clusters, and discrepancies discussed. Using Stebbins' value of $\Delta_{4170}^{4710} = 0{\cdot}12$ mag./kpc, and equivalent thickness of absorbing material in the direction of the north galactic pole of 125 parsecs is obtained. The influence of galactic longitude is examined.

M. W. Ovenden

523.872

3726. The spectrum of ζ Andromedae. M.-L. Tcheng. *Ann. Astrophys.*, **12**, 264–74 (*Oct.–Dec.*, 1949) *In French.*

523.877

3727. The electric charge of white dwarfs. E. Schatzman. *C.R. Acad. Sci., Paris*, **224**, 31–2 (*Jan.* 6, 1947) *In French.*

The ratio of charge to material density for a monatomic gas at zero temperature is estimated to be AG/Ze. The total charge for a star composed of H and a Russell mixture is very small, being of the same order as for main sequence stars. R. A. Newing

523.877

3728. Non-coherent scattering of light in stellar atmospheres. V. V. SOBOLEV. *Astr. J., USSR*, **26** (*No.* 3) 129 (1949) *In Russian.* Engl. Abstr. in *Astr. News Lett.* [*Harvard*] (*No.* 46).

Instead of determining approx. ε_ν as $f(\tau)$, the author solves Eddington's equation of radiative transfer for non-extended atmospheres $\cos\theta \cdot dI_\nu/dr = -(\sigma_\nu + \alpha)I_\nu + \varepsilon_\nu + \alpha B_\nu$ by setting $I(\nu, \nu_1, \eta, \zeta) = S_{\nu 1} r(\nu, \nu_1, \eta, \zeta)$ where $\pi S_{\nu 1}$ = intensity of incident light and ζ and η are the cosines of the angles of incidence and emergence. An expression for the function r, involving ε for the case of completely non-coherent scattering, is obtained from the condition that the addition of a thin layer of atmosphere does not alter the scattered light. r is shown to be a function of the quantity $\phi(x)$ where $x = \eta/(1 + \sigma_\nu/\alpha)$; $\phi(x)$ can be calculated from a simple expression. Similarly, $I(\nu', \eta)$ in a spectral line is calculated using the previously determined ϕ. Introduction of an explicit expression for ϕ yields a linear integral equation with a Cauchy-type core. Calculated central intensities show a strengthening which, together with fluorescent effects, is believed by the author to remove the existing discrepancy between observation and the theory of non-coherent scattering. Line contours for various η calculated from this new treatment are shown to be in essential agreement with observations of the variation of contour over the solar disc. M. W. OVENDEN

523.877

3729. A stellar model with a mixed opacity law. C. M. BONDI. *Mon. Not. Roy. Astr. Soc.*, **109** (*No.* 5) 571–9 (1949).

Stellar models are integrated in which the opacity is due both to photoelectric effect and to electron scattering. A.

523.877

3730. On the effect of radiation pressure in the atmospheres of early-type stars. A. B. UNDERHILL. *Mon. Not. Roy. Astr. Soc.*, **109** (*No.* 5) 562–70 (1949).

The effects of radiation pressure on the stability of the atmospheres of the high-temperature stars are discussed and it is shown that these effects are not negligible for stars with $T_e > 20\,000°$. An expression for the adiabatic gradient, $d \log T/d \log p_g$, in a mixture of radiation and an ionizable gas in thermodynamic equilibrium is obtained. A recent method, proposed by Unsöld, of obtaining the adiabatic gradient from entropy considerations is extended to include the effect of the radiation field. It is shown that stars of high effective temperature and low surface gravity probably do not have stable atmospheres. A.

523.877

3731. A note on the effects of radiation in the convection zone. A. B. UNDERHILL. *Ann. Astrophys.*, **12**, 243–6 (*Oct.–Dec.*, 1949).

Some relations of interest in the study of the convective zone in stars have been extended from validity for the case of an ionizable gas in thermodynamic equilibrium to that for an ionizable gas and radiation in thermodynamic equilibrium. A.

523.877

3732. Radial oscillations of compressible gas spheres. Z. KOPAL. *Proc. Nat. Acad. Sci., Wash.*, **30**, 72–84 (*Feb.*, 1950).

523.877 : 517.65

3733. The logarithms of the generalised exponential integral functions. K. KATTERBACH AND H. KRAUSE. *Z. Astrophys.*, **26** (*No.* 2–3) 137–46 (1949) *In German.*

In view of the importance of these functions, $K_n(x) = \int_1^\infty e^{-xt} t^{-n} dt$, for the theory of the radiative equilibrium in stellar atmospheres, their logarithms $\log_{10} K_n$ with their differences are here tabulated. These are approximately linear functions of x and thus permit a much simplified interpolation. The tables by V. Kourganoff [Abstr. 2647 (1948)] and G. Placzec [*Nat. Res. Council of Canada, Div. of Atomic Energy* (*No.* 1547) (1947)] served as basis. A. BEER

523.877 : 532.517.4

3734. Turbulence—a physical theory of astrophysical interest. S. CHANDRASEKHAR. *Astrophys. J.*, **110**, 329–39 (*Nov.*, 1949).

Recent developments in statistical theories are reviewed, and attention is drawn to the importance of Heisenberg's theory [see Abstr. 469, 4525 (1949)]. The role of turbulence in astrophysical and cosmological problems is also discussed. R. A. NEWING

525.35

3735. On the seasonal variation of the rotation of the earth. N. STOYKO. *C.R. Acad. Sci., Paris*, **230**, 514–15) *Feb.* 6, 1950) *In French.*

PHYSICS 53

53.081.5

3736. On systems with four principal quantities. R. ESNAULT-PELTERIE. *C.R. Acad. Sci., Paris*, **229**, 957–60 (*Nov.* 14, 1949) *In French.*

A continuation of previous work [*ibid.*, **225**, 606 (1947); **227**, 493 (1948)]. Two examples are now considered, and various formulae are established by dimensional analysis. The first example relates to a problem in surface tension, the second to an electrical circuit. L. S. GODDARD

53.081.5

3737. On the distinction between systems of principal quantities and systems of units. R. ESNAULT-PELTERIE. *C.R. Acad. Sci., Paris*, **229**, 1041–4 (*Nov.* 21, 1949) *In French.*

Further remarks about the dimensions of physical quantities [see preceding Abstr.]. A distinction is made between equations which are mathematical, physical or metrological. The latter express the units of one quantity in terms of those of other quantities. L. S. GODDARD

FUNDAMENTALS 530.1

530.1 : 538

3738. The fundamental relation between the magnetic moment and the structure of rotating celestial bodies. H. P. BERLAGE. Letter in *Nature, Lond.*, **165,** 242–3 (*Feb.* 11, 1950).

A celestial body is assumed to possess a degenerate core of radius r which acquires a negatively charged envelope and a positive superficial layer by electron migration. The magnetic moment produced by rotation is $\propto r^3 \times$ temperature at the surface of the core. This is shown to lead to a relation of Blackett's form, but the magnetic field at the surface of the body might be modified by the characteristics of the outer shell. R. A. NEWING

530.12

3739. Projective relativity theory with a variable gravitational invariant. G. LUGWIG. *Z. Phys.*, **124** (*No.* 7–12) 450–7 (1948) *In German.*

A field theory with a variable gravitational invariant is developed and the cosmological consequences are discussed. A method for obtaining the connection between projective and affine quantities is given. L. S. GODDARD

530.12

3740. On the theory of Birkhoff. M. KADOSCH. *Rev. Sci., Paris,* **86,** 707–10 (*Dec.*, 1948) *In French.*

Birkhoff's gravitational equations [Abstr. 839 (1945)] in Minkowski space-time give the force as a Newtonian attraction + a force perpendicular to the velocity. The analogy with electromagnetic equations is discussed. R. A. NEWING

530.12

3741. Concerning an article of O. Costa de Beauregard. P. DIVE, F. PRUNIER AND O. COSTA DE BEAUREGARD. *Rev. Sci., Paris,* **86,** 727–31 (*Dec.*, 1948) *In French.*

A polemical discussion of rigid bodies, rotating discs and similar topics in the special theory of relativity is continued. [See Abstr 2943 (1949)]. R. A. NEWING

530.12

3742. Principles of a new energy mechanics. J. MANDELKER. *New York; Philosophica Library* (1949) 73 *pp.*

This book contains an attempt to re-introduce into the "relativistic" mechanics of a particle a unique time by assuming that the velocity of light has a different value in each inertial system. The equivalence of mass and energy is also postulated. The dynamics of a particle is constructed and the bearing of the author's scheme on wave-mechanics is indicated. Neither the Michelson–Morley experiment nor the transformation-theory of Maxwell's equations is dealt with. G. C. MCVITTIE

530.12

3743. Relativity and statistics. A. MERCIER. *Proc. K. Ned. Akad. Wet.*, **53** (*No.* 1) 50–8 (1950) *In French.*

A non-mathematical discussion of the way in which quantization may be regarded as arising either from relativity or from statistics. P. M. DAVIDSON

530.12

3744. Resolution of the fundamental equations of a purely affine unitary theory. M. A. TONNELAT. *C.R. Acad. Sci., Paris,* **230,** 182–4 (*Jan.* 9, 1950) *In French.*

Equations proposed earlier [Abstr. 2945 (1949)] are developed. The interpretation of the tensors used is not clear. E. P. GEORGE

530.12

3745. Relativistic variation of rest mass. G. BECK. Letter in *Nature, Lond.*, **165,** 200–1 (*Feb.* 4, 1950).

It is shown that rest mass is conserved in the non-uniform motion of a charged particle according to the restricted theory only for a point charge. The general dependence of rest mass on fields might explain the slight mass variations of elementary particles. R. A. NEWING

530.12 : 517.42

3746. Relativity theory as a stimulus in mathematical research. H. WEYL. *Proc. Amer. Phil. Soc.*, **93,** 535–41 (*Dec.*, 1949).

Particular attention is paid to the impact of the general theory on developments in differential geometry. Cartan's treatment of Riemannian geometry is discussed. R. A. NEWING

530.12 : 521.5

Relativity effects in planetary motion. *See Abstr.* 3692

530.14

3747. Invariance in physical theory. E. P. WIGNER. *Proc. Amer. Phil. Soc.*, **93** (*No.* 7) 521–6 (1949).

The roles of invariance in classical physics, quantum mechanics and relativity are compared. The possibility of relating the conservation law for electric charge to some general principle of invariance is discussed. R. A. NEWING

530.145

3748. The self energy of protons and neutrons and the λ-limiting process. L. A. RADICATI. *Atti Accad. Sci. Torino,* **83** (*No.* 1) 82–8 (1947–49) *In Italian.*

Dirac's λ-limiting process, by means of which it is possible to eliminate divergencies in the calculation of the self-energy of a free electron, is extended to particles (nucleons) with an intrinsic magnetic moment. By quantizing the e.m. field as proposed by Dirac, and assuming that the nucleons may be described by a Dirac–Pauli equation, their self-energy remains also finite. It is pointed out however that, for a particle in a central field, this process leads to a vanishing reaction of the field, in contradiction with experimental results on the separation of the $2P_{1/2}$ and $2S_{1/2}$ levels of H. L. PINCHERLE

530.145

3749. Note on the magnetic moment of nucleons in the theory of meson pairs. J. L. LOPES. *An. Acad. Brazil Cienc.*, **21** (*No.* 4) 303–7 (1949) *In Portuguese.*

The process of re-normalization of charge and mass is applied to the calculation of the magnetic moment of proton and neutron under the assumption of a meson pairs interaction. Scalar (or pseudoscalar) and spinor fields are considered, the Hamiltonian being taken as independent of the derivatives of the field quantities. Despite the re-normalization, the

magnetic moment diverges logarithmically for both kinds of field. L. PINCHERLE

530.145

3750. Quantum theory of radiation damping for discrete states. W. HEITLER AND S. T. MA. *Proc. Roy. Irish Acad.*, **52 A**, 109–25 (*Feb.*, 1949).

The theory of radiation damping developed by Heitler and Peng [Abstr. 2558 (1942)] for collision processes in the continuous spectrum is applied to processes involving discrete levels of finite width. For this purpose, a Fourier transform is used, the time being replaced by an energy variable. Individual stationary processes are calculated for a fixed value of the energy variable, and transition probabilities obtained by the inverse transform. The theory of Weisskopf and Wigner on level widths is obtained as a special case, and it is verified that the equations give the correct propagation of light. H. MCMANUS

530.145

3751. On the calculation of electromagnetic phenomena by the field of neutral vector mesons of negligible mass. F. J. BELINFANTE. *Progr. Theor. Phys.*, **4**, 165–70 (*April–June*, 1949).

For purposes of calculation, the electromagnetic field can be replaced by a neutral vector meson field if the mass of the meson is afterwards put equal to zero. After elimination of the Coulomb field, there still remains an undesirable longitudinal meson field, but as the meson mass goes to zero, the coupling constant of this field with the matter field goes to zero, so it cannot give rise to any observable results. H. MCMANUS

530.145

3752. Classical electrodynamics in terms of direct inter-particle action. J. A. WHEELER AND R. P. FEYNMAN. *Rev. Mod. Phys.*, **21**, 425–34 (*July*, 1949).

If charged particles are considered to interact via a field, self-energy difficulties appear. These difficulties do not arise if it is postulated that the interaction is a direct one, i.e. if it can be expressed in terms of particle variables only. In this case, advanced and retarded interactions appear on the same footing, which gives rise to difficulties in the case of two particles. However, if a universe consisting of a large number of particles is considered, the advanced fields combine in such a way that each particle behaves as if it generated a retarded field only, which is satisfactory. H. MCMANUS

530.145

3753. Note on relativistic properties of self-energies. A. PAIS AND S. T. EPSTEIN. *Rev. Mod. Phys.*, **21**, 445–6 (*July*, 1949).

It is pointed out that the rules for interpretation of infinite self-energies lead to a finite value for the self-stress of an electron, and so the transformation of the self-energy from a rest system to a moving frame of reference does not agree with the direct calculation made in the moving reference system. H. MCMANUS

530.145

3754. Interaction of mesons with the electromagnetic field. W. H. FURRY AND M. NEUMAN. Letter in *Phys. Rev.*, **76**, 432 (*Aug.* 1, 1949).

Photon self-energy, meson self-energy, and polarization of the vacuum by a given current distribution are investigated for scalar and vector meson fields interacting with the electromagnetic field. H. MCMANUS

530.145

3755. The reaction of the meson field on a nucleon. H. KITA. Letter in *Progr. Theor. Phys.*, **4**, 566–7 (*Oct.–Dec.*, 1949).

The self-energy terms in the meson vacuum polarization can be expressed as mass renormalization. Expressions are given for all types of meson field. G. J. KYNCH

530.145

3756. Remarks on non-local spinor field. H. YUKAWA. Letter in *Phys. Rev.*, **76**, 1731 (*Dec.* 1, 1949).

In a previous letter [Abstr. 48 (1950)] the commutation relation $\beta_\mu[x^\mu, \psi] + \lambda\psi = 0$ between the spinor field ψ and the space-time operators x^μ was not invariant with respect to improper Lorentz transformations. This difficulty is removed by a new definition of the matrices β_μ. G. J. KYNCH

530.145

3757. The self-energy of the electron in an external electromagnetic field. G. GÉHÉNIAU AND F. VILLARS. *Helv. Phys. Acta*, **23** (*No.* 1–2) 178–86 (1950) *In French.*

The Schwinger method of calculating the self-energy can be extended, using functions $S(x, x^1)$ and $S^{(1)}(x, x^1)$ now defined as solutions of the Dirac equation with an external field. For a constant field the extra terms give the magnetic moment correction but no charge renormalization term. This method is also applied to find the self-energy of a proton in a pseudoscalar meson field with results in agreement with those obtained by other authors. G. J. KYNCH

530.145

3758. On the self-energy of a meson. E. CORINALDESI. Letter in *Nuovo Cim.*, **7**, 77–8 (*Jan.*, 1950).

A finite result had previously been obtained using Pauli's regularization technique. The identical result is shown to follow using Schwinger's method. It is also given by Dyson's transformation. E. P. GEORGE

530.145

3759. The diagonalization of the Hamiltonian in the theory of wave-fields. B. FERRETTI. Letter in *Nuovo Cim.*, **7**, 79–81 (*Jan.*, 1950) *In Italian.*

Dyson [see Abstr. 2338, 4487 (1949)] has shown how to use a generalized S-matrix to diagonalize the Hamiltonian of a wave-field (e.g. matter + radiation + interaction). In the present paper it is shown that, when the Hamiltonian does not depend on the derivatives of the field quantities, and if perturbation methods are applicable, Dyson's procedure may be used to calculate not only the S-matrix, but also the diagonal elements of H. L. PINCHERLE

530.145

3760. Note on a relation in Dirac's theory of the electron. G. E. BROWN. *Proc. Nat. Acad. Sci., Wash.*, **36**, 15–17 (*Jan.*, 1950).

Dirac's theory of the electron is applied to show that the hyperfine structure energy of an electron in a Coulomb field is $\propto$ the expectation value of the

operator r^{-2}, r representing the radius vector of the electron. P. T. LANDSBERG

530.145

3761. Reciprocal particles and Yukawa's theory of non-localisable fields. B. KWAL. *C.R. Acad. Sci., Paris*, **230**, 184–6 (*Jan.* 9, 1950) *In French.*

The solutions of Yukawa's equations are developed for particles of zero rest-mass. Their relation to Born's theory of reciprocal particles and to de Broglie's work in wave-mechanics is discussed. E. P. GEORGE

530.145

3762. Quantum theory of non-local fields. I. Free fields. H. YUKAWA. *Phys. Rev.*, **77**, 219–26 (*Jan.* 15, 1950).

The possibility of a theory of non-local fields, which is free from the restriction that field quantities are always point functions in the ordinary space, is investigated. Certain types of non-local fields, each satisfying a set of mutually compatible commutation relations, which can be obtained by extending familiar field equations for local fields in conformity with the principle of reciprocity, are considered in detail. Thus a scalar non-local field is obtained, which represents an assembly of particles with the mass, radius and spin 0, provided that the field is quantized according to the procedure similar to the method of second quantization in the usual field theory. Non-local vector and spinor fields corresponding to assemblies of particles with the finite radius and the spins 1 and $\frac{1}{2}$ respectively are obtained in the similar way. A.

530.145

3763. The equations of the theory of non-localised spinor fields. B. KWAL. *C.R. Acad. Sci., Paris*, **230**, 276–8 (*Jan.* 15, 1950) *In French.*

Draws attention to two points on which such theories, including that recently proposed by Yukawa, are unsatisfactory. P. M. DAVIDSON

530.145

3764. On the quantization of the metric field and the particle-field interactions. I. Application to the electric field. A. GIÃO. *C.R. Acad. Sci., Paris*, **230**, 278–80 (*Jan.* 16, 1950) *In French.*

The author's unified theory [see Abstr. 695 (1950)] is used to set up quantized field equations for a charged particle. The method gives a scalar potential identical with that introduced by de Broglie [Abstr. 242 (1950)]. R. A. NEWING

530.145

3765. On the calculation of self-energy of particles. S. N. GUPTA. Letter in *Phys. Rev.*, **77**, 294–5 (*Jan.* 15, 1950).

A generalization of a transformation due to Pauli [*Phys. Rev.*, **49**, 462 (1936)] is shown to lead to covariant self-energy expressions using ordinary perturbation theory. E. P. GEORGE

530.145

3766. A classical interpretation of the phenomena of materialization and dematerialization. F. J. WIŚNIEWSKI. *C.R. Acad. Sci., Paris*, **230**, 372–3 (*Jan.* 23, 1950) *In French.*

Dematerialization may be explained as the interpenetration of a positive and a negative electron, forming a particle having no mass, charge, or magnetic moment. Materialization is the separation of this particle into the two original electrons. P. M. DAVIDSON

530.145

3767. A note on the quantization of dissipative systems. W. E. BRITTIN. *Phys. Rev.*, **77**, 396–7 (*Feb.* 1, 1950).

The work of Kanai [*Progr. Theor. Phys.*, **3**, 440 (1948)] shows that the quantization of dissipative systems by use of a Hamiltonian formalism involving the time explicitly leads to results in disagreement with experience. The quantization of dissipative systems is discussed in a manner such that the time does not enter explicitly. It is shown that in the Heisenberg representation the only kind of dissipative forces consistent with the formalism are those which are functions of the coordinates alone. There exists no Schrödinger representation unless the forces are non-dissipative. A.

530.145

3768. Upper and lower bounds of eigenvalues. T. KATO. Letter in *Phys. Rev.*, **77**, 413 (*Feb.* 1, 1950).

530.145

3769. Non-localizable fields and reciprocity. M. BORN. *Nature, Lond.*, **165**, 269–70 (*Feb.* 18, 1950).

The significance of papers by Yukawa [Abstr. 50 (1950)] is discussed; especially, the fact that the reciprocal sets of equations separate into two sets, one describing the internal structures, the other the resultant motion. G. J. KYNCH

530.145

3770. Unified field theory in six dimensions. J. PODOLANSKI. *Proc. Roy. Soc. A*, **201**, 234–60 (*March* 22, 1950).

It is shown that a 6-dimensional—classical—field theory avoids the difficulties with which the Kaluza–Klein theory has to contend. Moreover, the possibility is gained of making the field energy of a point source finite. A geometric requirement (structure axiom) decomposes the 6-dimensional continuum. The space-time world appears as a subspace, immersed in the 6-dimensional space. Each world point corresponds to a sheet of physically indistinguishable points. Potentials and gauge transformation can be interpreted geometrically. As a consequence of the embedding, two fields of inertial forces (fields of constraint) occur. One behaves as the Maxwell field; the other has negative energy and can cancel the singularities of the electromagnetic one. The theory can be made conformally invariant and then yields a relation between the mass and the charges (the sources of the constraining fields). The presentation given in this paper is provisional, as it gives infinite range also to the field of negative energy. A.

530.145

3771. The interaction representation in the quantum theory of fields. J. S. DE WET. *Proc. Roy. Soc. A*, **201**, 284–96 (*March* 22, 1950).

It is shown that if two field operators with the same transformation character satisfy two different field equations, there is a unique unitary transformation connecting the field variables on any space-like surface given such a correspondence on one given

space-like surface. A differential equation for determining this unique unitary transformation is found which is the analogue of Tomonaga's generalized Schrödinger equation. This gives directly and simply an invariant interaction Hamiltonian and renders unnecessary the explicit verification of the integrability of the Schrödinger equation. To illustrate the simplification introduced, the interaction Hamiltonian for the interacting scalar meson-photon fields is calculated. The result is the same as that obtained by Kanesaya and Tomonaga, but it is obtained by a straightforward calculation without the need to add terms to make the Hamiltonian an invariant. A.

530.145 : 532.5

3772. Probability laws, hydrodynamical equations and quantum mechanics. J. Bass. *Rev. Sci., Paris*, **86**, 643–52 (*Nov.*, 1948) *In French.*

Some general remarks are made concerning the use of statistics in quantum mechanics. A function, f, called the pseudo-density of probability [Wigner: *Phys. Rev.*, **40**, 749 (1932)] is introduced, and its statistical significance is explained. An integro-differential equation satisfied by f is derived, and properties of hydrodynamical equations similar to this are discussed. An application is made to a system of particles, and the relevant equation is equivalent to that appearing in recent work by Born and Green [Abstr. 3435 (1947)]. L. S. GODDARD

530.145 : 537.122

3773. Finite relativistic charge-current distributions. D. Bohm, M. Weinstein and H. Kouts. Letter in *Phys. Rev.*, **76**, 867 (*Sept.* 15, 1949).

A finite relativistic charge-current distribution for the electron is proposed, which introduces another 4-vector (shape variable) in addition to the position variable. The current differs from that of the usual point particle in two ways. Firstly the delta-function is replaced by a finite invariant function of the position and shape variables, and secondly, a spin-like term is added to the current. H. McMANUS

530.145 : 537.122

3774. Vacuum polarization and e^4 charge renormalization for electrons. R. Jost and J. M. Luttinger. *Helv. Phys. Acta*, **23** (*No.* 1–2) 201–14 (1950) *In German.*

It is shown that in the treatment of vacuum polarization a compensation of the infinities of the self-charge cannot (for electrons) be due to a compensation between e^2 and e^4 self-energies. P. M. DAVIDSON

530.145 : 537.122

3775. The self-stress of the electron. F. Rohrlich. *Phys. Rev.*, **77**, 357–60 (*Feb.* 1, 1950).

The diagonal elements of the symmetrical energy-momentum tensor density of an electron at rest are calculated. The covariant formalism of Tomonaga, Schwinger, Feynman and Dyson is used, and it is shown that it is necessary to use a relativistic cut-off in addition to the covariant separation of the infinite renormalizations. Therefore "formalistic regulators" are used in the form of additional neutral vector fields. The integrations are carried out with the Feynman method. The resultant vanishing value for the self-stress constitutes a proof of the consistency of the relativistic formalism. It is also shown how the Feynman–Dyson method can be used for the calculation of expectation values of operators, of which the self-stress calculation constitutes an example. A.

530.145 : 537.122

3776. Fourth-order corrections in quantum electrodynamics and the magnetic moment of the electron. R. Karplus and N. M. Kroll. *Phys. Rev.*, **77**, 536–49 (*Feb.* 15, 1950).

The covariant S-matrix formalism of Dyson has been applied to the calculation of the fourth-order radiative correction to the magnetic moment of the electron. Intermediate results for the covariant Δ-functions which describe the interaction of virtual electrons and photons with the vacuum are given to order α. The addition to the magnetic moment to order α^2 is found to be finite after the charge of the electron is renormalized consistently. This correction amounts to $-2{\cdot}97\,\alpha^2/\pi^2$ Bohr magneton so that the magnetic moment of the electron is $\mu = 1{\cdot}001147$ Bohr magneton. A.

530.145 : 538.3

3777. Some notes on radiation theory. T. Awano. *J. Sci. Res. Inst., Tokyo*, **43**, 1–6 (*Dec.*, 1948).

The expansion of the radiation field in spherical waves and its subsequent quantization are outlined [cf. Abstr. 1179 (1936)]. G. J. KYNCH

530.145 : 539.18

3778. The effective cross-section in nucleon-nucleon scattering in the super-many-time theory. M. Jean and J. Prentki. *J. Phys. Radium*, **11**, 33–44 (*Jan.*, 1950) *In French.*

The method is applied to calculate the total cross-section and the angular distribution. It is shown that the results depend greatly on which of the modern theories of nuclear force is assumed, and should afford a good method of discriminating between them experimentally. P. M. DAVIDSON

530.145 : 539.18

3779. On a pseudoscalar theory of nuclear forces. C. Marty and J. Prentki. *C.R. Acad. Sci., Paris*, **230**, 54–5 (*Jan.* 2, 1950) *In French.*

It is demonstrated that, using the Born approximation, no mixture of charged and neutral pseudoscalar meson fields will give theoretical results in agreement with experimental observations of the scattering of neutrons by protons. E. P. GEORGE

530.145.6

3780. Relativistic quantum mechanics. W. Wessel. *Z. Naturforsch.*, **4a**, 645–53 (*Dec.*, 1949) *In German.*

The results, already published [Abstr. 1684 (1949)] of a generalized theory of the Dirac equation, are here derived by other methods, and the relationship of the theory to that of Bopp is discussed [Abstr. 1698 (1949)]. P. M. DAVIDSON

530.145.6

3781. Causality and structure of the S-matrix. E. C. G. Stueckelberg and D. Rivier. *Helv. Phys. Acta*, **23** (*No.* 1–2) 215–22 (1950) *In French.*

Starting from the equation of functional evolution and using invariant integration the operator S is obtained expanded in functions of translation operators. The coefficients define the structure of integral nuclei. From order $j = 2$ the terms for the

coefficients Sj diverge, which divergencies must then be eliminated. Since a satisfactory theory should not involve such corrections an alternative is suggested ensuring causality and unitarity of S at each step. Formally the results are the same; but the divergencies from second order onwards are replaced by indeterminate expressions. The new problem is to find S starting from an expression which is in part not defined. J. JACOBS

530.145.6

3782. Methods of integration common to classical and wave mechanics. R. FAURE. *C.R. Acad. Sci., Paris*, **230**, 364–5 (*Jan.* 23, 1950) *In French.*

530.145.6

3783. On the coupling of spinor variables for a system of Dirac electrons. J. G. VALATIN. *J. Phys. Radium*, **11**, 97–101 (*Feb.*, 1950) *In French.*

The operator representing the total spin of a system of f electrons, and 10 similar operators, are constructed in terms of the corresponding $4f$ Dirac matrices. The eigenvalues of these operators are determined using properties of the group of rotations in a space of 4, 5 and 6 dimensions.

P. T. LANDSBERG

530.145.6 : 539.152.1

3784. On the nuclear forces. H. ENATSU. Letter in *Progr. Theor. Phys.*, **4**, 572–3 (*Oct.–Dec.*, 1949).

A mixed neutral scalar-pseudoscalar meson field is suggested with modified interactions. The resulting potential is identical with that of Bethe [Abstr. 923 (1940)] and no contact terms appear. The suggestion is part of an attempt to obtain a correct anomalous magnetic moment. G. J. KYNCH

530.16

3785. On the problematic nature of certain *a posteriori* disjunctions on which the principle of the superposition of probabilities can be based. (Introduction of Hilbert space.) G. BODIOU. *C.R. Acad. Sci., Paris*, **230**, 180–2 (*Jan.* 9, 1950) *In French.*

530.162

3786. Statistical mechanics of condensed states. J. YVON. *J. Phys. Radium*, **10**, 373–80 (*Dec.*, 1949) *In French.*

Some general remarks are made concerning classical and quantum methods. Boltzmann's equation is still the only approximate procedure for irreversible phenomena. As examples in methods of calculation the following are discussed: density and its fluctuations, thermodynamic equilibrium, the equation of density distribution, the problem of condensation. The convergence of the fundamental equation in Fermi statistics is examined. Applications to problems of liquid helium are outlined.

L. S. GODDARD

530.162

3787. The foundation of quantum statistics. M. BORN; W. PAULI. *Nuovo Cim.*, **6** (*Suppl. No.* 2) 161–6 (1949).

A short review of general principles. The significance of Liouville's equation in classical and quantum mechanics is pointed out, and the theory of systems not in statistical equilibrium is discussed.

L. S. GODDARD

530.162

3788. Note after the conference by Prof. Born on the foundation of quantum statistics. W. PAULI. *Nuovo Cim.*, **6** (*Suppl. No.* 2) 166–9 (1949).

Further remarks concerning points raised in Professor Born's lecture. The two different methods of statistical interpretation of the tendency of a system to approach a state of thermal equilibrium are discussed. This conclusion is reached: "The fundamental difference between quantum mechanics and classical mechanics can not be made responsible for the statistical interpretation and foundation of the second law of thermodynamics."

L. S. GODDARD

530.162

3789. Distribution functions and integral equation methods. J. E. MAYER. *Nuovo Cim.*, **6** (*Suppl. No.* 2) 209–26 (1949).

The functions are useful in investigating the statistical mechanical properties of condensed phase systems. They are defined, and various properties are deduced. For computational purposes, a set of integral equations are introduced. Possible methods for solving these are discussed. The activities of phase transitions are connected with the eigenvalues of a Fredholm kernel. L. S. GODDARD

530.162 : 532.7

3790. The statistical mechanical theory of irreversible processes. J. G. KIRKWOOD. *Nuovo Cim.*, **6** (*Suppl. No.* 2) 233–9 (1949).

For the formulation and objectives of the theory [see Abstr. 2043 (1946)]. Applications of the theory to transport processes in pure liquids are reviewed. Problems of viscous fluid flow and heat conduction are studied, and formulae are derived for the coefficients of viscosity and heat conductivity. L. S. GODDARD

530.162 : 536.71

The caloric and thermal equation of states in classical and in quantum statistical mechanics. *See Abstr.* 4044

530.162 : 621.392.5

3791. Some aspects of Onsager's theory of reciprocal relations in irreversible processes. H. B. G. CASIMIR. *Nuovo Cim.*, **6** (*Suppl. No.* 2) 227–31 (1949).

Some remarks are made concerning Onsager's theory [*Phys. Rev.*, **38**, 2265 (1931)], and the theory is used in a discussion of passive electric networks, especially quadripoles. This extends previous work [Abstr. 2482 (1946)]. L. S. GODDARD

GENERAL MECHANICS . MECHANICS OF SOLIDS 531

531.224.8 : 621–272

3792. On highly compressible helical springs and rubber rods, and their application for vibration-free mountings. VI. J. A. HARINGX. *Philips Res. Rep.*, **4**, 407–48 (*Dec.*, 1949).

[See Abstr. 2201 (1950)]. The construction of some vibration-free mountings is considered, in particular, a damped dynamic vibration absorber supported by helical springs and an elementary

mounting without auxiliary mass supported by rubber rods. Their design is completely based upon the results found in the preceding papers, special attention being drawn to constructions approximately meeting the demands for the separation of the various degrees of freedom. The characteristic differences between helical springs and rubber rods when used as resilient elements are mentioned, the latter requiring a much larger mass for the same low resonant frequency of the system. A comprehensive treatment of the various resilient and damping elements is given in order to arrive at a number of formulae and graphs simplifying their design. A.

531.3

3793. Contribution to the study of stability. M. PARODI. *J. Phys. Radium* (*Sér.* 8) **10,** 348–52 (*Nov.*, 1949) *In French.*

531.382 : 621.313.333

3794. Magnetic suspension for small rotors. J. W. BEAMS. *Rev. Sci. Instrum.*, **21,** 182–4 (*Feb.*, 1950).

A magnetic suspension for small rotors has been developed which employs scattered light to regulate the vertical height of the rotor. Upon entering a horizontal beam of light the rotor scatters or reflects light into a p.e. multiplier. This actuates an electronic circuit which in turn regulates the current through the supporting solenoid to maintain the ferromagnetic rotor at the desired vertical position. Rotors with diameters down to 0·004 in have been stably supported. A $\frac{1}{64}$ in rotor was spun to an estimated speed of 800 000 rev/sec which gave a centrifugal field $>5\times10^8\,g$. Besides providing a support for rotors, the apparatus may be used as an analytical balance for weighing materials inside a vacuum chamber. It detects changes in mass of from 10^{-8} to 10^{-9} g. Other uses are also indicated. A.

531.4

3795. The determination of the friction couple in balanced rotating mechanism. D. A. RICHARDS. *Brit. J. Appl. Phys.*, **1,** 44–6 (*Feb.*, 1950).

A stroboscopic method is described which uses a lamp flashing at a fixed frequency, for the determination of the deceleration of balanced rotating mechanisms. From a knowledge of the moment of inertia of the mechanism, the friction couple, as a function of the speed, can be determined. The application of the method to the determination of the friction couple in a simple ballrace mechanism is described and some further applications are suggested. The method requires only the addition of a light stroboscopic disc to the mechanism. A.

531.53 : 621.318.3

3796. An electrically maintained pendulum. E. B. BROWN AND A. J. SHIMMINS. *J. Sci. Instrum.*, **27,** 57–9 (*March*, 1950).

The bob consists of a heavy coil across which a capacity is connected, forming a circuit nearly resonant at mains frequency. This coil swings along a laminated iron bar between two magnetizing coils on the bar carrying alternating current; these are connected in series with opposite polarity. Experimental results and the mathematical theory are given together with an analysis of the factors which affect the frequency and those which are responsible for maintaining oscillations. A.

531.564

3797. Effect of a squall upon the trajectory of a projectile. R. SÄNGER. *Helv. Phys. Acta*, **23** (*No.* 1–2) 143–58 (1950) *In German.*

531.571 : 536.46

Relation between explosion-temperature of a colloidal propellant and its rate of burning. *See Abstr.* 3118

MECHANICAL MEASUREMENTS 531.7

531.7 : 621.317.39

3798. Some electrical methods of measuring mechanical quantities. F. J. WOODCOCK. *Instn. Elect. Engrs, Paper No.* 901 (1950) 14 *pp.*

The paper deals with those methods of measuring mechanical quantities in which the initial mechanical-electrical transduction changes a resistance, capacitance or inductance, or generates an e.m.f. The wire-resistance strain gauge and the piezo-electric unit, however, are not considered. Consideration is given mainly to pick-up units (transducers). Their basic mechanical and electrical operating principles are briefly discussed, and typical examples are given, classified according to the electrical principles involved. The associated equipment is briefly reviewed. Particular reference is made to mechanical measurement problems associated with aeronautics. A.

531.72

3799. A new method of estimating the surface area of powder. M. MIZUSHIMA. Letter in *J. Chem. Phys.*, **17,** 1357 (*Dec.*, 1949).

The method suggested depends on obtaining the adsorption isotherm with a suitable liquid and the powder, and then measuring the contact angle.

J. IBALL.

531.72

3800. A reduction-of-area gage for use at low temperatures. G. W. GEIL AND N. L. CARWILE. *J. Res. Nat. Bur. Stand., Wash.*, **43,** 527–32 (*Dec.*, 1949).

531.72 : 541.183

3801. Surface areas of crystalline carbon and carbide powders as measured by the adsorption of nitrogen. F. E. BARTELL AND C. G. DODD. *J. Phys. Coll. Chem.*, **54,** 114–28 (*Jan.*, 1950).

531.74

3802. The measurement of small prism angles. C. VON HOFE. *Optik*, **6,** 14–19 (*Jan.*, 1950) *In German.*

531.787

3803. A simple pressure balance. C. A. SWENSON. *Rev. Sci. Instrum.*, **21,** 22–4 (*Jan.*, 1950).

A simple pressure balance is described for use in the range 25–35 atm. It gives pressures reproducible from day to day to about 0.01 atm. A.

531.787.9

3804. Design and use of piezoelectric gauges for measurement of large transient pressures. A. B. ARONS AND R. H. COLE. *Rev. Sci. Instrum.*, **21,** 31–8 (*Jan.*, 1950).

Discusses the design and use of piezoelectric gauges for the measurement of rapidly varying hydrostatic

pressures of large amplitude in gaseous and liquid media. Reasons are given for the selection of tourmaline in preference to other types of crystal. Fundamental principles of design are stated, and gauge construction is described in the light of these principles. A simplified theoretical analysis of transient response characteristics is presented. A.

MECHANICS OF FLUIDS 532

532.13

3805. Structure viscosity of viscose. A. LUDE. *Rec. Trav. Chim. Pays-Bas*, **68**, 1030–6 (*Dec.*, 1949) *In French.*

532.13 : 541.182.42

3806. Viscosity of water in oil emulsions. P. SHERMAN. Letter in *Research, Lond.*, **2**, 587–8 (*Dec.*, 1949).

532.133

3807. On the question of the *B*-coefficient in the Jones–Dole equation. E. ASMUS. *Z. Naturforsch.*, **4a**, 587–94 (*Nov.*, 1949) *In German.*

The values of B in the Jones–Dole equation ($\eta_r = 1 + A\sqrt{c} + Bc$) connecting the relative viscosity η_r of aqueous solutions of strong electrolytes with concentration c, have been determined for a large number of electrolytes, and the ionic contributions to B have been calculated. The cationic values were obtained as a rule from the η functions of chlorides and nitrates and sometimes sulphates. The values for anions were obtained from determinations for Na and K salts. The $F_{25/100}$ values [$F_{25/100} = (\eta_0 l_\infty)_{25°}/(\eta_0 l_\infty)_{100°}$, where l = dilution] were calculated and plotted against the B coefficients. There is a discontinuity in the curve at Li^+ probably due to the commencement of a second hydration sphere with this ion. The connection between B and the hydration entropy and the lyotropic number of the ions is examined. The curve of B against hydration entropy consists of two straight lines which intersect at Li^+; the B-lyotropic number curve is linear. The effect on B of non-electrolytic impurities in the water used in the preparation of the solution is considered. The S-shaped curve of $\psi(= A + B\sqrt{c})$ against $\sqrt{c}$ which has been found for $MgSO_4$ is due to the secondary influence of such impurities; if these are eliminated the curve is linear. A. J. MEE

532.5 : 530.145

Probability laws, hydrodynamical equations and quantum mechanics. *See Abstr.* 3772

532.51

3808. The instability of liquid surfaces when accelerated in a direction perpendicular to their planes. I. G. TAYLOR. *Proc. Roy. Soc. A*, **201**, 192–6 (*March* 22, 1950).

532.517

3809. On irrotational motion of a viscous liquid. G. SUPINO. *Atti Acad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **6**, 615–20 (*May*); 708–10 (*June*, 1949) *In Italian.*

It is shown that in general the motion of a viscous liquid cannot be irrotational; but various conditions under which an irrotational character is possible are investigated. The type of flow in a limited field or a simply connected field is investigated. L. S. GODDARD

532.517

3810. Continuous movement of a viscous fluid between two rotating discs. P. CASAL. *C.R. Acad. Sci., Paris*, **230**, 178–9 (*Jan.* 9, 1950) *In French.*

532.517.4

3811. Statistical hydrodynamics. L. ONSAGER. *Nuovo Cim.* **6** (*Suppl. No.* 2) 279–87 (1949).

A partial explanation is given of the formation of large isolated vortices in unsteady flow. A 2-dimensional statistical model consisting of n parallel vortices is considered, but the limitations of this model are pointed out. A simple type of turbulence is analysed. This is nearly homogeneous and isotropic and may be produced by a grid in a streaming gas. The main ideas in the theory of this turbulence are reviewed. L. S. GODDARD

532.517.4

3812. The decay of turbulence. Z. SHIROGANE. *J. Soc. Appl. Mech. Japan*, **2** (*No.* 12) 135–9 (1949) *In Japanese.*

In isotropic turbulence, assuming that the Reynolds stress is relaxed, the vortex diffuses from one part of the flow to another part as a random walk, and the rate of the change of intensity of the vortex with respect to time equal to the rigidity of the fluid, the law of the decay of turbulence, the mean square of the distance through which the vortex diffuses Y^2, and the diameter of vortex λ are found. A.

532.517.4 : 523.877

Turbulence—a physical theory of astrophysical interest. *See Abstr.* 3734

532.52

3813. Interfacial instability and mixing in stratified flows. G. H. KEULEGAN. *J. Res. Nat. Bur. Stand., Wash.*, **43**, 487–500 (*Nov.*, 1949).

When a liquid flows over a body of heavier liquid, with which it is miscible, an interface may be formed at which there is a sharp discontinuity of densities but not necessarily of velocities. As the relative velocity is increased, waves are formed at the interface, and at a critical velocity, mixing begins by the formation of eddies periodically ejected from the crests of the waves. The numerical values of a criterion for mixing, whose form was derived from theoretical considerations, were determined experimentally. Experimental data were also obtained on the relation of the amount of mixing to the relative velocity of the liquids at velocities > critical. A.

532.52

3814. Bernoulli's theorem for viscous compressible fluids. C. TRUESDELL. *Phys. Rev.*, **77**, 535–6 (*Feb.* 15, 1950).

532.56 : 550.342

On hydrodynamic earthquake effects. *See Abstr.* 4502

532.57

3815. A method of measuring flowing media in tubes by means of Röntgen or γ rays. R. BURGHOLZ. *Arch. tech. Messen., Issue No.* 167 (*Ref. V*1247–2) *T*107 (*Dec.*, 1949) *In German.*

Two methods are described; in the first, the radia-

tion casts a shadow of a flap which is deflected by the medium. The deflection is related to the velocity of flow. In the second method an absorber, rotated by the medium, interrupts a collimated beam of the radiation falling on a G.M. tube. The frequency of interruption is $\propto$ the velocity of flow. J. HUGHES

532.582.3

3816. The resistance of a submerged cylinder in accelerated motion. T. H. HAVELOCK. *Quart. J. Mech. Appl. Math.*, **2**, 419–27 (*Dec.*, 1949).

532.59

3817. Relation between band slicks at the surface and internal waves in the sea. G. C. EWING. *Science*, **111**, 91–4 (*Jan.* 27, 1950).

CAPILLARITY 532.6

532.6.08

3818. A pendent-drop apparatus for surface and interfacial tensions. H. W. DOUGLAS. *J. Sci. Instrum.*, **27**, 67–9 (*March*, 1950).

Constructional details are given of a 2-part thermostat and a syringe holder for use with a Pyrex syringe and tip and a rectangular optical cell employed in the measurement of the boundary tension of liquid/gas and liquid/liquid systems. A brief account is also given of the optical system employed and of the method by which the tensions have been evaluated. A table is given comparing representative tensions so obtained with corresponding values from the literature. The agreement between them is very satisfactory. A.

532.63

3819. Heat effects in capillary flow. I. H. C. BRINKMAN. *Appl. Sci. Res.*, **A 2** (*No.* 2) 120–4 (1950).

The temperature distribution in a capillary due to the energy dissipation of viscous flow is calculated while the heat conductivity of the fluid and the transport of heat by convection are taken into account. A.

532.64

3820. Wetting and contact angle hysteresis. S. BAXTER. Letter in *Nature, Lond.*, **165**, 198 (*Feb.* 4, 1950).

For a solid in contact with liquid and air $\gamma_{SA} - \gamma_{SL} = k\gamma_{LA}$ where γ_{SA}, γ_{SL} and γ_{LA} are the surface free energies per unit area of the solid/air, solid/liquid and liquid/air interfaces respectively and when $k \geqslant 1$ the liquid is said to wet the solid. k cannot be measured directly, since in such cases no finite contact angle exists. However if a drop of liquid is placed on a thin porous surface it will penetrate the surface and will arrange itself symmetrically on both sides. [See Abstr. 515 (1945)]. Then the "contact angle" θ_E which this drop makes to the porous surface is measurable and is related to k by the equation $\cos\theta_E = f/2k$ where f is the area of solid-air interface per unit geometrical area of porous surface. For liquids such as benzene, aniline, diethyl phthalate on fine Ni and Cu structures [see Abstr. 2324 (1949)] $k = 1$ and remained the same value when wetting agents were added. In all these cases no contact angle hysteresis was observed. It is concluded that in such cases the liquid is spreading over an adsorbed layer of itself which completely covers the solid surface. J. IBALL

532.65

3821. Envelopes of oil drops suspended in glue solution. S. MATHEWS. *Research, Lond.*, **3**, 86–90 (*Feb.*, 1950).

The oil/glue solution interface was studied by the elongated pendent drop shape method. Interfacial and membrane tensions were deduced from the shape of the pendent drop. The solid nature of the mature linseed oil/glue solution membrane was established. A.

532.65 : 551.578.1

The size distribution of raindrops. *See Abstr.* 4549.

532.66

3822. Dependence of capillary rise on the length of capillary. G. ANTONOFF. *Experientia*, **6** (*No.* 2) 52 (1950).

532.68

3823. The structure of paper. D. TOLLENAAR AND G. BLOKHUIS. *Appl. Sci. Res.*, **A 2** (*No.* 2) 125–41 (1950).

The flow of liquid in porous material can be approximately described by two constants, the mean pore radius r and the pore density N. This simple description is inadequate to explain the striking-away phenomenon, the height of rise when the capillary pressure and the hydrostatic pressure are in equilibrium, and to calculate the weight of liquid risen. A new structure description with more constants, assuming a size distribution of the pore radii, presents the possibility of overcoming these difficulties. The Gaussian distribution involves 3 constants: the most frequent pore radius r_0, a density factor n_0 and a factor α, determining the standard deviation of r_0. The striking-away phenomenon is explained by the difference in capillary pressure between narrow and wide capillaries, as a result of which the liquid present in the wide pores is forced into the narrow ones. A.

MOLECULAR THEORY OF LIQUIDS 532.7

532.72

3824. Membrane equilibria, the Gibbs–Dalton law and the entropy of mixing. E. A. FLOOD AND G. C. BENSON. *Canad. J. Res. B*, **27**, 988–1014 (*Dec.*, 1949).

532.72

3825. A diaphragm cell for thermal diffusion measurements. E. S. HUSE, D. J. TREVOY AND H. G. DRICKAMER. *Rev. Sci. Instrum.*, **21**, 60–1 (*Jan.*, 1950).

A cell using a fritted glass disc is described. The results obtained are consistent with those obtained for other cells, and operation is simpler and shorter than for most other methods. A.

532.72 : 535.42

3826. Diffraction micromethod for measuring diffusion coefficients in liquids. M. S. KHAÏKIN. *J. Tech. Phys., USSR*, **19**, 1370–9 (*Dec.*, 1949) *In Russian.*

532.73

3827. Factors determining solubility among non-electrolytes. J. H. HILDEBRAND. *Proc. Nat. Acad. Sci., Wash.*, **36**, 7–15 (*Jan.*, 1950).

532.73 : 541.64

3828. Experimental study of the Maxwell effect of solutions of chain macromolecules as a function of solvent viscosity. R. CERF. *C.R. Acad. Sci., Paris*, **230**, 81–3 (*Jan.* 2, 1950) *In French.*

Tobacco mosaic virus in water obeys the theoretical formula for a rigid particle while polystyrene in cyclohexanone behaves like an elastic sphere rather than a "statistical filament" as regards variation of $(\tan \alpha)_0$ from 0–60°C. D. H. WHIFFEN

532.74 : 539.185

Neutron diffraction in liquid sulfur, lead and bismuth. *See Abstr.* 4378

MECHANICS OF GASES 533

533.15

3829. Diffusion properties of gases. III. The diffusion and thermal diffusion coefficients for isotopic gases and gas mixtures. E. R. S. WINTER. *Trans. Faraday Soc.*, **46**, 81–92 (*Feb.*, 1950).

Recent calculations by Hirschfelder, Bird and Spotz [Abstr. 3019 (1949)] of the Chapman and Enskog gas collision integrals, for the Lennard–Jones 12 : 6 model have been used to test the ability of the model to predict the diffusion and thermal diffusion properties of binary gas mixtures and of isotopic gases. For isotopic gases the model gives results in fair agreement with experiment, although there are not sufficient experimental data to enable a critical comparison to be made. For gas mixtures the use of

$$E(0)_{12} = \{E(0)_{11} \cdot E(0)_{22}\}^{\frac{1}{2}}$$

and

$$r(0)_{12} = \{r(0)_{11} + r(0)_{22}\}/2$$

is preferred; these assignments of the interaction energies and diameters for the collision of pairs of unlike gas molecules give rise to close agreement between theory and experiment for rare gas mixtures, and fairly reasonable agreement for other gas mixtures. A.

533.15

3830. Separation of gases by fractional permeation through membranes. S. WELLER AND W. A. STEINER. *J. Appl. Phys.*, **21**, 279–83 (*April*, 1950).

The permeability of a number of thin organic films toward O_2 and N_2 has been measured. For an ethyl cellulose film the studies were extended to include CO_2, A, He and H_2. The enrichment of a binary gas mixture in a single stage of permeation has been calculated for the extreme cases of perfect mixing and no mixing. Application of these results indicates that the use of a fractional permeation process may be of practical importance in effecting the separation of O_2 from air, helium from natural gas, and H_2 from coke-oven gas, as examples. A.

533.15 : 539.163

An experimental determination of the distribution of the radon decay products in a gas-filled spherical vessel. *See Abstr.* 4288

533.16 : 536.26

3831. The viscosity and heat conductivity of steam. F. G. KEYES. *J. Amer. Chem. Soc.*, **72**, 433–6 (*Jan.*, 1950).

Measurements of the heat conductivity of steam to 350° and 150 atm. have been made using a concentric cylinder device especially adapted for measurements under pressure. Comparison with data published by Timroth and Vargaftig obtained through the use of hot wire method shows the new values to be lower by amounts up to 38% (150 atm.). The low pressure (zero) values of T. and V. exhibit a trend to very high values with increasing temperature which is not verified in new measurements. A correlation of the viscosity values of steam due to Timroth and to Hawkins, Solberg and Potter has been carried out. The values of the latter are believed to be the more reliable. The value of the ratio, heat conductivity, by the product, specific heat and viscosity, is 1·2 and independent of temperature between 100 and 600°. The ratio decreases with pressure increase. A.

533.24

3832. A multi-stage turbo-expander air liquefier. A. BOSE. *Indian J. Phys.*, **23**, 433–44 (*Nov.*, 1949).

A new type of air liquefier, depending upon the adiabatic expansion of the compressed gas in a multi-stage turbine of low speed, is described. The actual method of liquefaction depends on precooling a suitable fraction of the compressed gas in a heat exchanger, by the other part of the gas cooled by its expansion below the critical point in the turbine, when the former liquefies under its own pressure. The great advantage of such a method is discussed. Preliminary calculations for a small liquefier gives a practical efficiency of about 0·6 kWh per kgm of liquid air. A.

533.5

3833. An audible vacuum-leak indicator. J. T. LLOYD. *J. Sci. Instrum.*, **27**, 76 (*March*, 1950).

533.6.011

3834. An extension of the theory of diabatic flow. B. L. HICKS. Letter in *Phys. Rev.*, **77**, 286 (*Jan.* 15, 1950).

533.6.011 : 533.7 : 536.7

3835. The thermodynamics of flow systems. C. F. CURTISS AND J. O. HIRSCHFELDER. *J. Chem. Phys.*, **18**, 171–3 (*Feb.*, 1950).

The rate of change of entropy in a flow system is evaluated explicitly taking into account heat conductivity, viscosity, diffusion and chemical reactions. The equations are developed rigorously from the kinetic theory of gases. A.

533.6.011.311

3836. Integration of the laminar boundary layer equation. I. Motion of an elliptic cylinder. Separation. D. MEKSYN. *Proc. Roy. Soc. A*, **201**, 268–78 (*March* 22, 1950).

533.6.011.311

3837. Integration of the laminar boundary layer equation. II. Retarded flow along a semi-infinite plane. D. MEKSYN. *Proc. Roy. Soc. A*, **201**, 279–83 (*March* 22, 1950).

533.6.011.5

3838. The numerical method of characteristics for supersonic flows with axial symmetry. M. HOLT. *Quart. J. Mech. Appl. Math.*, **2**, 473–8 (*Dec.*, 1949).

533.6.07 : 536.551

3839. A versatile pneumatic instrument based on critical flow. W. A. WILDHACK. *Rev. Sci. Instrum.*, **21**, 25–30 (*Jan.*, 1950).

Gas flows through two restrictions in series, the second one or both being a nozzle operating with sonic throat velocity so that discharge is independent of the downstream pressure. For fixed restrictions, the ratio of entrance pressures at the two restrictions depends on their relative sizes and the ratio of entrance temperatures. After calibration, the pressure ratio may be used to measure temperature with a sensitivity of 1°c or better over a range of 2000°c. With the same arrangement, the temperature being constant, the intermediate pressure is a direct measure of mass flow. A sensitivity of better than 0·1% is possible in this measurement. For given temperatures, the device can be used as a "pressure divider," with the intermediate pressure controlled by adjusting the restrictions, or as a pneumatic micrometer. Gas analysis is accomplished by removing one component of the gas flow between nozzles. A vacuum pump is used, if necessary, to ensure critical discharge through one or both nozzles; divergent cones on nozzles may be used to minimize pressure drop. A.

533.6.07 : 537.523

3840. An investigation of the possible use of the glow discharge as a means for measuring air flow characteristics. F. D. WERNER. *Rev. Sci. Instrum.*, **21**, 61–8 (*Jan.*, 1950).

The glow discharge in air at atmospheric pressure from a point of fine Pt wire has been investigated. It is found that the glow current is markedly pressure sensitive, has low velocity sensitivity, is only slightly humidity sensitive, and is negligibly sensitive to ordinary temperature variations. The device offers a significant improvement over conventional pressure measuring instruments by the small size of its sensitive portion (of the order of 0·001 in diameter wire and 0·002 in glow diameter) and in its response to high frequency variations (more than 10^6 c/s has been demonstrated experimentally). It suffers from high background noise in the present arrangement. A.

533.6.08 : 532.517.4

3841. Hot-wire anemometry of turbulent currents. P. VERNOTTE. *C.R. Acad. Sci., Paris*, **230**, 58–9 (*Jan.* 2, 1950) *In French.*

The author restates a fundamental objection which he put forward a long time ago, but which, he claims, has not been fully appreciated by aerodynamicists. Hot-wire anemometry depends upon the relation between the convective heat-loss of a wire and the velocity of the ambient gas. For steady flow the convection coefficient is well established, but for flows which vary in space and time it may be altered. If this is so, it is of doubtful validity to use the hot-wire anemometer to measure the small flow-perturbations arising in turbulent flow, because the change in heat loss observed may arise as much from alteration of the convection coefficient as from modifications of the flow-field. A. SCHOFIELD

MOLECULAR THEORY OF GASES 5333

533.72 : 536.2

3842. On the influence of accommodation coefficient on the heat conductivity and radiometer force in gases. S. WEBER. *K. Danske Vidensk. Selsk. Mat.-fys. Medd.*, **19** (*No.* 11) (1942) *In German.*

533.7

3843. Transport properties of gases. K. E. GREW. Letter in *J. Chem. Phys.*, **18**, 149–50 (*Jan.*, 1950).

See Abstr. 3019 (1949).

533.73 : 541.12

3844. On the perturbation of Maxwell distribution function by chemical reactions in gases. I. PRIGOGINE AND E. XHROUET. *Physica*, **15**, 913–32 (*Dec.*, 1949).

It is shown that the Chapman–Enskog method of calculating the perturbation of the Maxwell distribution introduced by spatial gradients can be generalized to include the effect of chemical reaction. The perturbation can be calculated exactly by integrating an integro-differential equation analogous to that of Maxwell–Boltzmann. The method is illustrated by considering the initial stages of a reaction of the type $A + A \rightarrow B + C$, neglecting the effect of heat of reaction. Perturbation of the velocity distribution lowers the rate of reaction to an extent depending on the value of E/kT (E = energy of activation, k = Boltzmann's const., T = temp.); the decrease in reaction rate is also affected by the proportion of inelastic collisions occurring in a particular frequency range. For ordinary reactions ($E/kT > 5$) with a small heat of reaction, the change in reaction rate arising from perturbation of the velocity distribution is negligible. A. SCHOFIELD

533.73 : 541.12

3845. On the perturbation of the Maxwell distribution by chemical reaction in the gase phase. II. I. PRIGOGINE AND M. MAHIEU. *Physica*, **16**, 51–64 (*Jan.*, 1950) *In French.*

The second of a series devoted to the extension of Chapman–Enskog's method to inelastic collisions [see Abstr. 3844 (1950)]. It is mainly concerned with the study of the influence of the heat of reaction on the Maxwell distribution. As shown in the first paper this effect is in general small for the activation energy. The heat of reaction, however, can perturb the Maxwell distribution to an appreciable extent. As a result, the reaction rate is increased for exothermal, decreased for endothermal reactions. The effect is especially important for exothermal reactions. At the same time, the order of the reaction is increased. The calculations have been performed for the initial rate of a reaction of the type $A_0 + B \rightarrow A_1 + B$. In this case the result can be expressed by the following equation: $v = v^{(0)}(1 + 1{\cdot}2x_{A_0}x_B r_{VT}/\varepsilon)$, where ε is the activation energy, r_{VT} the heat of reaction and $x_{A_0}x_B$ the mole fractions of A_0 and B; $v^{(0)}$ is the reaction rate estimated by assuming Maxwell distributions for each constituent. A

533.73 : 541.12

3846. On the perturbation of the Maxwell distribution by chemical reactions. I. PRIGOGINE. *Nuovo Cim.*, **6** (*Suppl. No.* 2) 289–96 (1949) *In French.*

The method of Chapman and Enskog is generalized

so as to apply to chemical reactions. The perturbation of the equilibrium distribution is calculated by integrating an equation which generalizes that of Maxwell–Boltzmann. The results show that the Maxwell approximation may be used in calculating the reaction rates for reactions, without thermal effect, whose energy of activation is $<$ about $5kT$.

L. S. GODDARD

533.77 : 541.124

On thermal reactions in the gas phase. II. *See Abstr.* 4417

VIBRATIONS . ACOUSTICS 534

534

3847. Acoustics and some allied studies. A. WOOD. "*Resonant absorbers and radiation*" (*Phys. Soc., Lond.*, 1949) 1–9.

Inaugural address.

534.01

3848. General expression for the instantaneous frequency of a damped sinusoidal oscillator, when the damping varies slowly and aperiodically as a function of the amplitude. J. ABELÉ. *Ann. Franç. Chronom.*, **3** (*No.* 4) 409–16 (1949) *In French.*

The equation of the oscillator is $z'' - 2a\omega z' + \omega^2 z = 0$, where a is an aperiodic function of the amplitude. An analysis, based on this equation, leads to an explicit expression for the instantaneous frequency. This is discussed in several particular cases.

L. S. GODDARD

534.01

3849. Small vibratory movements of an elastic body with propagation of first-order discontinuities. A. CHARRUEAU. *C.R. Acad. Sci., Paris*, **230**, 361–2 (*Jan.* 23, 1950).

534.01 : 539.37

3850. On small motions in not completely elastic bodies. F. GASSMANN. *Schweiz. Bauztg*, **67**, 55–6 (*Jan.* 22, 1949) *In German.*

A linear differential operator is defined and used to generalize Hooke's law. The equations of motion of a medium are derived and the propagation of longitudinal and transverse waves is discussed. The form the operators take for various special bodies is given.

J. E. CAFFYN

534.113 : 539.32

A resonant bar method for determining the elastic properties of thin lamina. *See Abstr.* 4403

534.121.2

3851. A slight improvement of Southwell's method for the approximative computation of the lowest frequency of a homogeneous membrane. A. M. SCHULTE. *Appl. Sci. Res.*, **A 2** (*No.* 2) 93–6 (1950).

534.154

3852. Contribution to the measurement of vibration. M. WEBER. *Diss. E.T.H. Zurich*, 32 *pp.* (1949) *In German.*

The most general vibration is considered theoretically. The theoretical basis for the construction of a vibration meter with simple frequency characteristic is given, and accuracy of measurement is determined. Indications are given. Calibration and measurement are described. An accelerometer has been constructed, and calibrated in accordance with the above-mentioned theory, sensitivity being sufficient for practical purposes.

A.

534.21

3853. A method of measuring ultrasonic pulse velocities. R. JONES AND E. N. GATFIELD. *Mag. Concr. Res.* (*No.* 2) 77–8 (*June*, 1949).

See Abstr. 3870 (1950).

534.21

3854. Transmission of reverberant sound through single walls. A. LONDON. "*Noise and sound transmission*, 1948" (*Phys. Soc., Lond.*, 1949) 194–200.

Random incidence sound-transmission measurements were made on homogeneous walls of Al, plywood and plaster-board. The results were found to be in satisfactory agreement with a modified version of a theoretical treatment first given by Cremer which postulates that the wall impedance has a resistive component in addition to its mass reactance and a stiffness reactance resulting from the occurrence of flexural waves. 2 of the 3 parameters which are required to predict the transmission loss, namely resistance, and critical flexure frequency, the third one being mass, are evaluated from the experimental data in such a way as to obtain the best fit between the theoretical and experimental results.

A.

534.21

3855. Experimental contribution to the measurement of ultrasonic absorption in liquids. D. SETTE. *Nuovo Cim.*, **7**, 55–63 (*Jan.*, 1950) *In Italian.*

An optical method is described and results given.

534.22 : 539.32

3856. Variation of elastic moduli and wave velocity with pressure and temperature in plastics. D. S. HUGHES, E. B. BLANKENSHIP AND R. L. MIMS. *J. Appl. Phys.*, **21**, 294–7 (*April*, 1950).

The variations in velocity of dilatational waves in the pressure range 0 to 15 000 lb/in^2 and temperature range 30° to 90°C have been measured for samples of polystyrene, Lucite and polyethylene. The velocity of rotational waves was also measured for polystyrene and Lucite. In polyethylene no trace of a rotational wave could be identified. The elastic moduli and Poisson's ratio are computed over the experimental range.

A.

534.221

3857. The velocity of propagation of ultrasonic waves in mixtures of liquids. D. SETTE. *Ric. Sci.*, **19**, 1338–79 (*Nov.–Dec.*, 1949) *In Italian.*

An up-to-date review of the subject with many tables and extensive references.

L. PINCHERLE

534.221

3858. Ultrasonic measurements in metallic beryllium at low temperatures. W. C. OVERTON, JR. *J. Chem. Phys.*, **18**, 113–15 (*Jan.*, 1950).

Using the ultrasonic pulse method, the velocity of longitudinal waves in metallic Be has been measured from 300°K to 23°K, and transverse waves from 300°K to 3°K. The adiabatic moduli and compressibility have been computed from the velocities. A new

technique for affixing the quartz transducer to the solid for ultrasonic measurements, in suitable solids, below 100°K, has been successfully employed. A.

534.222.2

3859. One-dimensional flow behind a steady plane detonation. S. PATERSON. Letter in *Research, Lond.*, **3**, 99–100 (*Feb.*, 1950).

534.222.2

3860. The dispersion of a pressure pulse in the atmosphere. R. S. SCORER. *Proc. Roy. Soc. A*, **201**, 137–57 (*March* 7, 1950).

The object is to find what pressure oscillations would be observed on the ground at a great distance from an explosion. The explosion is represented by a Fourier integral, corresponding to the introduction of a large volume into the atmosphere at a point on the ground. The resulting pulse is calculated for various distances for a model atmosphere consisting of a troposphere with a constant lapse-rate of temperature and an isothermal stratosphere. It is composed of those oscillations that can be propagated horizontally as gravity waves in this model atmosphere, namely, those of period exceeding a cut-off period of 111 sec. The pulse consists of a series of waves of decreasing amplitude and period, terminating with a period of 12·7 sec. The results are compared with the oscillations observed on the occasion of the fall of the Great Siberian meteorite. A.

534.222.2 : 539.172.4

3861. The formation of a blast wave by a very intense explosion. II. The atomic explosion of 1945. G. TAYLOR. *Proc. Roy. Soc. A*, **201**, 175–86 (*March* 22, 1950).

Photographs of the first atomic explosion in New Mexico were measured, and the radius, R, of the luminous globe or "ball of fire" determined for a large-range of values of t, the time measured from the start of the explosion. The relationship predicted in Part I namely, that $R^{\frac{5}{2}}$ is $\propto t$, is verified over a range from $R = 20$ to 185 m. The value of $R^{\frac{5}{2}}t^{-1}$ so found was used in conjunction with the formulae of Part I to estimate the energy E generated in the explosion. Two estimates are given in terms of the number of tons of T.N.T. which would release the same energy. The first (probably the more accurate) is 16 800 tons. The second, 23 700 tons, probably overestimates the energy, but is included to show the amount of error which might be expected if the effect of radiation were neglected and that of high temperature on the specific heat of air were taken into account. Reasons are given for believing that these two effects neutralize one another. After the explosion a hemispherical volume of very hot gas is left behind and the photographs were used to measure the velocity of rise of the glowing centre of the heated volume. This velocity was found to be 35 m/sec. Until the hot air suffers turbulent mixing with the surrounding cold air it may be expected to rise like a large bubble in water. The radius of the "equivalent bubble" is calculated and found to be 293 m. The vertical velocity of a bubble of this radius is $\frac{2}{3}\sqrt{(g\,29300)}$ or 35·7 m/sec. The agreement with the measured value, 35 m/sec, is better than the nature of the measurements permits one to expect. A.

534.23

3862. Energy movement in the field of a spherical sound radiator. S. N. RZHEVKIN. *J. Tech. Phys. USSR*, **19**, 1380–96 (*Dec.*, 1949) *In Russian.*

A generalized expression is given for the acoustic field of a composite spherical sound radiator, involving spherical Bessel and Neumann functions. The connection is shown between the conventional Stokes–Rayleigh functions $f(jkr)$ and $F(jkr)$ and the new, more convenient functions $G(kr)$, $D(kr)$, $\varepsilon(kr)$ and $\delta(kr)$. The problem of the energy fluxes is investigated and it is established that in the field of simple radiators tangential energy currents are absent whereas they are always present with composite radiators. As an example, the field of the radiator of order $(0 + 1)$ is analysed in detail, general expressions being obtained for the "additive energy" and "additive mass" of zonal and sectorial radiators of any order.

B. F. KRAU

534.232 : 621.395.623.

3863. Crystal receivers for portable deaf-aids. W. GÜTTNER. *Z. angew. Phys.*, **2** (*No.* 1) 33–9 (1950) *In German.*

An electrical equivalent circuit is developed for a double-plate Rochelle salt crystal, coupled to a Helmholtz resonator. The results are applied to the design of a miniature sound-reproducer. Curves are given, showing a working frequency range of 200 to 4 000 c/s, and it is stated that a sufficiently large sound output is obtained for an input of 5 mVA.

V. G. WELSBY

534.25 : 541.64

3864. The acoustic birefringence of macromolecular solutions. A. PETERLIN. *Rec. Trav. Chim. Pays-Bas*, **69**, 14–21 (*Jan.*, 1950) *In French.*

534.26

3865. Sound scatterers in the sea. R. W. RAITT. *J. Mar. Res.*, **7**, 393–409 (*Nov.*, 1948).

Oscillograph records were made of sound which, after radiation into the sea, was scattered back to the source, presumably by biological organisms having density and compressibility close to that of sea water. Pulses 3 msec long of 24 kc/s sound were radiated vertically downward. The numerous echoes received at the source due to backward scattering usually causes a reverberant effect, but under favourable conditions individual echoes can be observed. A statistical study was made of the acoustic size of the scatterers as a function of depth. It was found that most of the scattering in the top 180 m of the sea off Lower California was due to scatterers having acoustic cross-sections between 0·1 and 10 cm². Most of the larger scatterers were concentrated at the lower depths. In the layer from 20 m to 90 m below the surface, there were about $1{\cdot}5\times10^{-5}$ scatterers per m³ having acoustic cross-sections > 1 cm², but from 90 m to 180 m below the surface the number was about 7×10^{-5} per m³ of sea water.

APPLIED MECHANICS REVIEWS

534.26

3866. On the freely vibrating circular disk and the diffraction by circular disks and apertures. C. J. BOUWKAMP. *Physica*, **16**, 1–16 (*Jan.*, 1950).

A theory of the acoustic field produced by a freely

vibrating, rigid, circular disc is developed on the assumption that the wavelength is $\geqslant$ the radius of the disc. The solution is presented in the form of a series of ascending powers of wave number times radius of disc. The new approach, which is based on integral equations, easily permits the explicit calculation of a number of terms of this series. The results are equally applicable to the diffraction at circular discs and apertures, of plane scalar waves impinging in the normal direction upon the obstacle. A survey of earlier results by various authors is included. A.

534.321.9

3867. Velocity of ultrasonics in an electric field and influence of temperature. A. BONETTI. *Ric. Sci.*, **18,** 777–80 (*July*, 1948) *In Italian.*

534.321.9 : 534.844

3868. Ultrasonic reverberation measurements in liquids II. C. E. MULDERS. *Appl. Sci. Res.*, **B1** (*No.* 5) 341–57 (1950).

A formula is given for the ultrasonic reverberation in a vessel, filled with a liquid. The contributions of the different causes of absorption of energy to the total attentuation of sound are discussed. The formula has been checked experimentally and is used for the determination of the absorption of sound in aqueous solutions of several salts, especially $MgSO_4$. [See Abstr. 1769 (1949)]. A.

534.321.9 : 535.42 : 621.397.3

3869. On the modulation of light at radiofrequency by means of ultrasonics. A. GIACOMINI. *Ric. Sci.*, **18,** 803–8 (*July*, 1948) *In Italian.*

534.321.9 : 578

Ultrasonic tissue disintegrator. *See Abstr.* 4564

534.321.9 : 620.179.16 : 693.5

3870. The non-destructive testing of concrete. R. JONES. *Mag. Concr. Res* (*No.* 2) 67–76 (*June*, 1949).

A method is described to determine the velocity of longitudinal waves in concrete specimens by measuring the time taken for an ultrasonic pulse to travel through a known length of concrete. Results are given which illustrate the use of the method. A.

534.647

3871. Velocity-acceleration response from a seismic pick-up via controlled damping. R. J. JEFFRIES. *Rev. Sci. Instrum.*, **21,** 115–17 (*Feb.*, 1950).

The basic theory of the seismic pick-up is developed and interpreted to show that it is theoretically possible to make a simple seismic system directly amplitude-sensitive to velocity as well as acceleration and/or displacement. This is accomplished by appropriate control of the damping. A.

534.78

3872. An artificial mouth for acoustic experiments. P. CHEVASSE. *C.R. Acad. Sci., Paris,* **230,** 436–8 (*Jan.* 30) *In French.*

534.83 : 534.23

3873. Noise and sound transmission. *Phys. Soc., Lond.* (1949) 200 *pp.*

Report of the 1948 Summer Symposium of the Acoustics Group of the Physical Society. 41 papers, dealing with noise measurement and noise sources, sound insulation in buildings and the measurement of transmission for various materials and structures. Individual papers are abstracted independently.

534.833.1

3874. Sound transmission through partitions. L. L. BERANEK. "*Noise and sound transmission*, 1948" (*Phys. Soc., Lond.*, 1949) 1–6.

A method is described for measuring the transmission and absorption of sound by panels using a battery of loudspeakers closely coupled to the panel. Experiments are described which verify that the attenuation of sound by multiple absorptive structures can be calculated from the density flow resistance and dimensions of the components. G. F. HODSMAN

534.833.1

3875. On the transmission of sound by elastic panels. T. VOGEL. "*Noise and sound transmission*, 1948" (*Phys. Soc., Lond.*, 1949) 16–21.

The problem has been investigated with a view to its application to sound insulation of aircraft. The transparence is deduced theoretically, of a rectangular plate supported at the edges and of two such plates separated by a thin layer of air. The transparence of a plate coated with a porous layer is also considered. An automatic recording method for measuring transparence ratios is described and results are given which show fair agreement with the theory.

G. F. HODSMAN

534.833.1

3876. Sound-insulation of panels at oblique incidence. L. CREMER. "*Noise and sound transmission*, 1948" (*Phys. Soc., Lond.*, 1949) 23–6.

The influence of angle of incidence on measurements of the transmission loss through insulating panels is emphasized. The effect of resistance to bending becomes more important with oblique incidence and a correction is derived for the usual transmission loss formula for normal incidence. It is shown how the insulating properties may be improved by decreasing the stiffness of thin panels. G. F. HODSMAN

534.834

3877. Sound damping in ducts. P. V. BRÜEL. "*Noise and sound transmission*, 1948" (*Phys. Soc., Lond.*, 1949) 152–9.

The problem is examined theoretically with particular reference to the elimination of noise from fans in artificial ventilation systems, Formulae are tabulated which enable the attenuation in ducts to be calculated from a knowledge of the dimensions of the duct and the position and properties of the absorbent lining. The advantages of using high-speed fans with effectively damped ducts rather than low speed fans with undamped ducts are stressed. G. F. HODSMAN

534.839

3878. Noise measurement—a review of the problem. R. S. DADSON. "*Noise and sound transmission*, 1948" (*Phys. Soc., Lond.*, 1949) 120–4.

534.839

3879. Instruments for measuring vibration and noise. R. S. HOGBEN. "*Noise and sound transmission*, 1948" (*Phys. Soc., Lond.*, 1949) 132–5.

Details are given of an electromagnetic pick-up for measuring linear velocities of vibration between $0{\cdot}5\times10^{-3}$ and $8{\cdot}0$ cm/sec (r.m.s.) subject to a limitation of $1{\cdot}5$ mm on the double amplitude or

40 *g* on the acceleration. The response is sensibly uniform from 20 c/s up to at least 2 000 c/s. An electrically driven vibrating table for calibrating vibration measuring devices is also described and details are given of a frequency analyser covering the range 30 to 25 000 c/s—with a filter whose bandwidth can, if required, be only 1·2 c/s wide.

G. F. HODSMAN

534.839

3880. Considerations concerning a standard for the measuring of impact sound. V. L. JORDAN. "*Noise and sound transmission*, 1948" (*Phys. Soc., Lond.*, 1949) 45–7.

The adoption of standards for the sound insulation of building structures necessitates an agreed reliable test method. Various methods and definitions are critically discussed and the importance of testing floors for ability to damp noises from impacts in the room itself is stressed. Pending the development of a more suitable sound generator, it is suggested that an intermediate standard should be adopted which should prescribe a standard tapping machine, define a transmission loss figure and take into account both insulating and damping properties of floors.

G. F. HODSMAN

534.839

3881. Provisonal code for field and laboratory measurements of airborne and impact sound insulation. P. H. PARKIN. "*Noise and sound transmission*, 1948" (*Phys. Soc., Lond.*, 1949) 36–44.

534.845

3882. The relation between the coefficient of absorption and Sabine's coefficient. J. GRUNENWALDT. "*Noise and sound transmission*, 1948" (*Phys. Soc., Lond.*, 1949) 93–6.

Observed differences between the coefficient of absorption measured by observation on stationary waves set up in front of the test material and the absorption as measured by reverberation formulae are discussed and a general solution of the problem has been given, which enables a theoretical relationship to be deduced between absorption coefficients obtained by the different techniques. Experimental confirmation over a wide range of absorption coefficients is given.

G. F. HODSMAN

534.87 : 621.389

3883. Obstacle detection using ultrasonic waves in air. G. BRADFIELD. *Electronic Engng*, **21**, 464–8 (*Dec.*, 1949).

Describes the results which have been achieved with simple equipment for use as a safety-in-fog aid to road transport, or blind man's aid, to detect the proximity of on-coming traffic, up- or down-going steps, walls, windows, etc. Expressions are given for determining the optimum frequency for certain conditions, e.g. at 20 ft, large objects require a frequency of 23 kc/s, but clusters of tiny objects require 50 kc/s. A spark transmitter was used with a standard 14 mm sparking plug at the focus of a reflector. The receiving microphone used a double bimorph Rochelle crystal at the focus of a 5 in paraboloid. The spark rate was 3 to 4/sec and duration 1–1½ μsec. Tables are given showing the amplitude of the reflected signal at various frequencies for different objects.

B. B. AUSTIN (R)

535.14

3884. Principle of spectral analysis and mean values in the wave mechanics of the photon. S. SLANSKY. *C.R. Acad. Sci., Paris*, **230**, 275–6 (*Jan.* 16, 1950) *In French.*

Discusses the interpretation of an apparent inconsistency arising in de Broglie's theory of light (*Une nouvelle théorie de la lumiere*, Paris, 1940).

P. M. DAVIDSON

535.214 : 538.69

3885. Photophoresis and magnetophotophoresis of particles of omega iron in air at different pressures. P. TAUZIN. *C.R. Acad. Sci., Paris*, **230**, 77–9 (*Jan.* 2, 1950) *In French.*

Both these effects are more pronounced for pressures between 1 mm and 10 mm Hg. Some particles are observed to follow helical paths, which cannot be accounted for on photophoresis grounds. It is suggested that the classical experiments of Nichols and Hull on radiation pressure should be repeated, as some of the effects seen may be due to photophoresis.

N. CORCORAN

535.24

3886. Heterochromatic photometry of incandescent lamps. J. TERRIEN. *C.R. Acad. Sci., Paris*, **230**, 531–2 (*Feb.* 6, 1950) *In French.*

535.24 + 535.65 + 536.62

3887. Some instruments for precise photometric, colorimetric and polarimetric measurements. Y. ÖHMAN. *Rev. Opt.* (*Théor. Instrum.*) **29**, 32–4 (*Jan.*, 1950) *In French.*

Mentions a number of instruments developed at the Stockholm observatory that have been described earlier (1936–46). Briefly describes a new instrument with an optical train consisting of a rotating polarizer, two quartz plates cut parallel and perpendicular to the optic axis respectively, an analyser and a photocell; the second quartz plate introduces rotatory dispersion. For a certain position of the analyser, depending on the spectral energy distribution of the incident light, the photocurrent shows no fluctuation as the polarizer rotates. Determination of this position gives a parameter to express the colour of a star. A simplified arrangement measures the polarization of light from the moon.

G. F. LOTHIAN

535.241.3

3888. On the standard source for low level photometry. K. S. WEAVER. Letter in *J. Opt. Soc. Amer.*, **40**, 60 (*Jan.*, 1950).

535.243

3889. Construction of a double beam recording infra-red spectrophotometer. J. U. WHITE AND M. D. LISTON. *J. Opt. Soc. Amer.*, **40**, 29–35 (*Jan.*, 1950).

A spectrometer recording directly in % transmission *v.* wavelength has been built on the principles described by Wright [Abstr. 1803 (1947)]. The spectrometer and recorder are a single unit (40 in long, 22 in high, 20 in wide) with external amplifier and power supplies. The instrument makes direct reading transmission records on 34 in × 11 in charts; employs a 60° Littrow

mounted rock salt prism with 60×75 mm faces; has 5 in of length available for sample cells in each beam. Wavelengths and slit widths are read directly on Veeder counters. Wavelength scanning speed varies from about 5 min to 200 hr for the rock salt region; speed of response from about 4 sec to over a minute for full scale, with the possibility of a further increase to 5 min if needed; resolution from close to the theoretical limit of the prism to about a tenth as much; paper drive speeds to give uniform scales from 1 to 50 in per micron by integral factors. By changing cams, spectra can be recorded on constant wave number of other scales. Changes may be made to accommodate prisms of LiF, KBr and other materials. The general features and arrangement of the new instrument are described. A.

535.243

3890. Amplification and electrical systems for a double beam recording infra-red spectrophotometer. M. D. Liston and J. U. White. *J. Opt. Soc. Amer.*, **40**, 36–41 (*Jan.*, 1950).

[See preceding Abstr.]. The system has been designed and built around a pin-type thermocouple, 13 c/s chopper, 13 c/s amplifier and synchronous rectifier. The subsequent circuits modulate the rectified output to 60 c/s for operation of a 2-phase servo balance motor and automatic suppression of the wavelength scanning speed whenever a pen servo error exists. An independent circuit employs a tapped potentiometer as an electrical cam to control the monochromator slit width to give relatively constant energy output at 7 energy levels. A total of 18 tubes are employed, with 3 of them in the 13 c/s amplifier. The first tube is operated at reduced voltage with a floating grid following a 300 : 1 gain transformer. Special construction of the preamplifier greatly reduces the susceptibility to 60 c/s pick-up over previous amplifiers. A.

535.243

3891. Performance of a double-beam recording infra-red spectrophotometer. J. U. White and M. D. Liston. *J. Opt. Soc. Amer.*, **40**, 93–101 (*Feb.*, 1950).

The performance of the instrument of Abstr. 3890 (1950) is described. A.

535.243

3892. Recording spectroradiometers for luminescent materials. S. L. Parsons, A. E. Martin and S. N. Roberto. *J. Electrochem. Soc.*, **97**, 41–8 (*Feb.*, 1950).

Describes two automatic instruments for the direct measurement of spectral energy in the region between 7,200 and 3 600 Å. The fluorescent lamp spectroradiometer plots a permanent record on a chart in 12·5 min while the cathode-ray tube instrument performs the measurement in 48 sec. A.

535.247

3893. Reduction of light by means of periodic interruption. J. J. B. Moerman. *Electro-techniek*, **28**, 49–53 (*Feb.* 2, 1950) *In Dutch.*

The use of the rotating sector is analysed and discussed. A.

535.31

3894. The mathematical content of Rayleigh's rule. G. Toraldo di Francia. *Atti Fond.* "*Giorgio Ronchi*," **1**, 136–9 (*Oct.–Dec.*, 1946) *In Italian.*

A consideration of the aberrational diffraction integral by means of a vector diagram shows that the definition (= max. intensity of aberrated wave/max. intensity of spherical wave) has a lower limit of 0·5, if the aberration does not exceed $\lambda/4$.

H. H. HOPKINS

535.31

3895. An energy basis for optical resolution. V. Ronchi. *Ric. Sci.*, **19**, 1273–94 (*Nov.–Dec.*, 1949) *In Italian.*

The classical theories on the formation of optical images are criticized and it is suggested that they should be re-formulated taking primarily into account the photometric characteristics of the radiation, and the properties of the detector (eye, photographic plate, etc.) This paper synthesizes the results of nearly 80 contributions to the subject made over a period of 20 years by the Istituto Nazionale di Ottica in Florence. L. PINCHERLE

535.31 : 516

3896. Non-euclidean geometry and geometrical optics. I–II. B. Segré. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **7**, 16–26 (*July–Oct.*, 1949) *In Italian.*

535.31 : 535.8

3897. Introduction to the geometrical and interference theory of aberrated waves. I. G. Toraldo di Francia. *Atti Fond.* "*Giorgio Ronchio*," **1**, 78–88 (*June–Aug.*, 1946) *In Italian.*

Discusses the known results of the wave optical theory of aberrations. The results comprise expressions for transverse aberrations in terms of the derivatives of the wave-aberrations, and the terms to be added to this latter in consequence of transverse and longitudinal displacements of the chosen focus.

H. H. HOPKINS

535.31 : 535.8

3898. Introduction to the geometrical and interference theory of aberrated waves. II. G. Toraldo di Francia. *Atti Fond.* "*Giorgio Ronchi*," **1**, 122–35 (*Oct.–Dec.*, 1946) *In Italian.*

Establishes a differential equation which is satisfied by the caustic of an aberrated wave, and shows how the wave aberration may be found from integrations of the transverse ray aberrations. The forms of the first-order aberration terms are then given and discussed in relation to the $\lambda/4$ limit. The known results are given. H. H. HOPKINS

535.31 : 535.8

3899. Introduction to the geometrical and interference theory of aberrated waves. III. G. Toraldo di Francia. *Atti Fond.* "*Giorgio Ronchi*," **2**, 25–42 (*Feb.–April*, 1947) *In Italian.*

Treats the theory of fringes associated with aberrated wavefronts as seen under the Ronchi grating test. The known appearances are described.

H. H. HOPKINS

535.311

3900. The meaning of the law of the rectilinear propagation of light in wave optics. F. Croze and P. Boillet. *C.R. Acad. Sci., Paris*, **230**, 200–3 (*Jan.* 9, 1950) *In French.*

There is a difficulty in the usual proof of rectilinear propagation if a point source (A) is considered because the amplitude from the outer Fresnel zones do not die

away to zero even when the angle $AMB = 90°$, where B is the point at which the intensity is being considered and M is a point on a Fresnel zone. It is shown quantitatively that this difficulty disappears if the source has finite dimensions ($> \lambda$). G. F. LOTHIAN

535.312

3901. Determination of reflected and transmitted fields by geometrical optics. J. B. KELLER AND H. B. KELLER. *J. Opt. Soc. Amer.*, **40**, 48–52 (*Jan.*, 1950).

By an extension of ordinary geometrical optics (or acoustics) the intensity of the reflected and transmitted fields due to a point source in the presence of an arbitrary interface between two media is found. Particular consequences of the solution are the general lens and mirror law and the equations for the caustic surfaces. A.

535.313

3902. Total tolerance of the third order for a spherical mirror. G. TORALDO DI FRANCIA. *Atti Fond. "Giorgio Ronchi,"* **2**, 140–6 (*Oct.–Dec.*, 1947) *In Italian.*

For a given angle of field, the aperture of a spherical mirror (of given radius) for which both axial and extra-axial imagery satisfy the Rayleigh $\lambda/4$ tolerance is found. Curves are given for mirrors of radius 5, 10, 20 and 50 cm showing the max. permissible angle of field as a function of the angular aperture.

H. H. HOPKINS

535.313 : 535.412

3903. Study of the interference fringes in the neighbourhood of caustics. E. DURAND. *Ann. Phys., Paris*, **3**, 621–36 (*Nov.–Dec.*, 1948) *In French.*

When a parallel beam of light is reflected by a spherical mirror the caustic is an epicycloid. By considering optical paths along rays incident in the neighbourhood of 45°, the spacing of a dense system of fringes is calculated. Experiments using a concave mirror (radius of curvature = 40·8 cm, diameter = 4·8 cm) have provided photographs confirming these calculations. The intensity distribution in the fringes has been calculated on a geometrical and a diffraction basis. In the latter case the wave front is looked upon as a "deformed" cylinder, and Kirchhoff's integral is used in the form involving zero order Hankel functions. Fringes have also been photographed with the reflected beam limited by a narrow slit. H. H. HOPKINS

535.313.2

3904. A zonal mirror free from asymmetric errors. P.-E. WEBER. *Optik*, **5**, 319–25 (*Aug.*, 1949) *In German.*

Describes a concave mirror built of annular zones, each having its own radius of curvature; the successive zones are displaced stepwise along the axis so that they all lie on a circle whose diameter is equal to the focal length. The various zones are made of separate Al castings; a 5-zone mirror has been made, focal length 100 mm, aperture about 82 mm. With rays incident at 15° to the axis the performance has been tested by measuring the increase in intensity as an aperture diaphragm is opened. The mirror is compared with parabolic and Schmidt mirrors, and the Seidel aberrations are discussed; it should be useful for searchlight and stage projection.

G. F. LOTHIAN

535.317

3905. Study of the aberrations of decentration. Tolerances on the centering of optical instruments. A. MARÉCHAL. *Rev. Opt. (Théor. Instrum.)* **29**, 1–24 (*Jan.*, 1950) *In French.*

The optical system is divided into two parts, *a* and *b*. *a* is given a lateral translation and a rotation relative to *b*. Paraxially the errors are simply those of "perspective," while the aberrations introduced depend only on the aberrations of the part of the system (*a* or *b*) which does not contain the diaphragm. It is shown that the first-order aberrations suffice for the calculation of the tolerances on centering. The effect of decentration is then to introduce terms similar to those of the Seidel aberrations, but lacking rotational symmetry in the image plane, and showing dependence on different powers of the angle of field. Two new types of distortion are introduced. In the first "vertical" lines remain unaffected (in one preferred direction) while "horizontal" lines are curved and displaced. In the second "vertical" lines are also no longer parallel in the image. The formulae lead to tolerances, and these have been calculated and checked experimentally for a telescope doublet, a microscope objective and a wide-field aerial camera lens. H. H. HOPKINS

535.317.1 : 535.822

3906. On the theory of image formation in the microscope. IV. M. BEREK. *Optik*, **5**, 1–30 (*April*, 1949) *In German.*

A continuation of previous paper [Abstr. 1409 (1949)]. The image of an ultra-microscopic inhomogeneity in a bright field is calculated. The contrast of the image is found for varying phase retardations in the object, and for narrow beam, ring and wide angle illumination. Tables, graphs and contrast contours along the axis in the neighbourhood of the Gaussian image plane are given for a number of special cases. R. W. FISH

535.317.1 : 535.822

3907. On the theory of image formation in the microscope. V. M. BEREK. *Optik*, **5**, 144–59 (*June*, 1949) *In German.*

A continuation of preceding paper. Results for single point objects are applied to the image of objects with microscopic structure. The general problem is discussed, with particular reference to the type of illumination, to self-luminous bodies and the enhanced contrast obtained with phase contrast methods. R. W. FISH

535.317.1 : 535.822

3908. On the theory of image formation in the microscope. VI. M. BEREK. *Optik*, **5**, 329–53 (*Sept.*, 1949) *In German.*

Previous results for a single point object are applied to the case of two ultra-microscopic point objects. The relative contrast in the image plane is found as a function of phase retardation and separation of points. The resolving power is deduced for self-luminous bodies, and opaque bodies with bright and dark field illumination. Results are generalized to the case of 3 or more equi-spaced object points. R. W. FISH

535.317.3

3909. The chromatic variation of aberrations within the Seidel region. A. WEYRAUCH. *Optik*, **5**, 414–18 (*Oct.*, 1949) *In German.*

The chromatic variations of the primary lens aberrations are obtained from the known paraxial chromatic aberrations and the variation of the Seidel coefficients, of primary aberration, with refractive index. Expressions given are in a form suitable for computation. R. W. FISH

535.317.4

3910. The interference test for photographic objectives with spherical correction giving a minimum circle of confusion. G. TORALDO DI FRANCIA AND C. CALCAGNILE. *Atti Fond.* "*Giorgio Ronchi*," **2**, 89–95 (*June–Aug.*, 1947) *In Italian.*

It is shown that a lens corrected according to the criterion of an earlier paper [see Abstr. 3911 (1950)] has characteristic fringes under a Ronchi grating test. The form of these fringes is calculated, and illustrated by computed examples. H. H. HOPKINS

535.317.4

3911. On the correction of the spherical aberration of photographic objectives. G. TORALDO DI FRANCIA. *Atti Fond.* "*Giorgio Ronchi*," **1**, 42–7 (*Oct.–Dec.*, 1946) *In Italian.*

It is shown that the minimum geometrical circle of confusion is obtained when the zonal longitudinal aberration (zone $= 1/\sqrt{2}$ margin) is $1\frac{1}{2}\times$ that of the margin, and is of the same size. With the same "ray" criterion, it is shown that the position of the best focus is then between the marginal and zonal ray foci, at a distance from the paraxial focal plane $= \frac{5}{4}\times$ the marginal longitudinal aberration. No mention is made of aberrational diffraction theory. H. H. HOPKINS

535.317.5

3912. The determination of 5th-order aberrations of centred optical systems. F. WACHENDORF. *Optik*, **5**, 30–122 (*April*, 1949) *In German.*

Refraction at a curved surface is treated in terms of the direction cosines of the rays, their intersection with the vertex plane, the radius of the surface and its departure from a sphere. Expansion in a power series yields six 3rd-order (Seidel) coefficients and twelve 5th-order coefficients. Transfer equations are given for further surfaces. For a complete system, the Seidel coefficients are shown to be additive, while the 5th-order coefficients involve product terms of the Seidel constants as well as addition terms of the individual 5th-order coefficients. These results are shown to agree with the Schwarzschild Eikonal method. Computing schedules are given for practical use in optical design. R. W. FISH

535.317.5

3913. The influence of monochromatic aberrations up to the 5th order on image quality as given by the method of mean squares. F. WACHENDORF. *Optik*, **5**, 129–43 (*June*, 1949) *In German.*

The definition of an axial point object is judged by the mean square intensity in its image plane. The position of best focus can be found in the presence of aberrations up to the 5th order. Results are extended to extra-axial points and to the field as a whole. The necessary relationships between the 3rd- and 5th-order aberration coefficients for the best overall definition are given as functions of lens aperture, image size and position. R. W. FISH

535.317.5

3914. On the aberrations of the field-flattened Schmidt camera. E. H. LINFOOT AND P. A. WAYMAN. *Mon. Not. Roy. Astr. Soc.*, **109** (*No.* 5) 535–56 (1949).

535.322.4

3915. Light density in optically dense media. H.-J. HELWIG. *Optik*, **5**, 419–25 (*Oct.*, 1949) *In German.*

When a beam is refracted into an optically dense medium the angle of the limiting rays is reduced and consequently the light density (flux per unit area) is increased. A formula is developed in which light density is shown $\propto \mu^2$; it is tested using a beam through a cell of liquid, the light density being measured by using an opal screen of defined area with a photocell behind. The theory is regarded as confirmed, but it remains to be seen whether the method will be useful for measurement of μ. G. F. LOTHIAN

535.323

3916. Optical effects in bulk silicon and germanium. H. B. BRIGGS. Letter in *Phys. Rev.*, **77**, 287 (*Jan.* 15, 1950).

These substances are transparent in the near infrared—Si between 1·2 and 6 μ, Ge between 2 and 6·5 μ. Prisms have been made and refractive index (μ) measured to a precision of a few tenths per cent. At $\lambda = 1{\cdot}8\ \mu$, Si has $\mu = 3{\cdot}466$ and Ge, $\mu = 4{\cdot}143$; at $\lambda = 2{\cdot}6\ \mu$, corresponding values are 3·443, 4·068. At $\lambda = 1{\cdot}8\ \mu$, Ge shows $d\mu/dT$ positive. A Ge lens has been made. Reflection losses are high, but the transmission of a Ge window was increased from 50% to 90% by surface films of Se. G. F. LOTHIAN

535.323 : 548.0

Optics of ethylenediamine tartrate at elevated temperatures. *See Abstr.* 4467

535.323–15

3917. Separation of near infra-red radiation by means of prisms. II. Comparison of the dispersion of various substances. J. LECOMTE. *J. Phys. Radium*, **11**, 67–9 (*Feb.*, 1950) *In French.*

New experimental values of the dispersion of 3 glasses are compared with the dispersion of quartz, LiF, CaF_2, NaCl and CS_2 from 1–2 μ. D. H. WHIFFEN

535.33 : 778.3

3918. Photographing spectra in the vacuum ultraviolet. A. L. SCHOEN AND E. S. HODGE. *J. Opt. Soc. Amer.*, **40**, 23–8 (*Jan.*, 1950).

Sensitive materials for photographing the far-u.v. spectrum usually require either a fluorescent overcoating on the emulsion or a sensitive Ag halide layer containing a low concentration of gelatin on the surface. The characteristics of a new photographic material of the latter type are described. Tests indicate that the new emulsion has higher sensitivity, greater contrast, lower fog, and is processed by a simpler procedure than previously available materials. The absorption effect of gelatin is shown. A.

535.33.03

3919. A new high intensity source of continuous ultra violet and the measurement of its spectral energy distribution by fluorescence photometry with a photomultiplier. J. EWLES. *Proc. Leeds Phil. Lit. Soc.*, **5**, 236–9 (*Dec.*, 1949).

The performance of a Kr arc is described.

535.33.072

3920. New types of apparatus for analyses by emission spectrography. W. ROLLWAGEN. *Optik*, **5**, 395–405 (*Oct.*, 1949) *In German.*

A description of photometric equipment, including spectrograph, measuring microscope, projection microscope and photometer head. The instruments are compact and comprehensive. No new principles are involved. S. TOLANSKY

535.33.072

3921. Visual spectrum analysis with the test spectrum and the observation-casette. E. PREUSS. *Optik*, **5**, 406–13 (*Oct.*, 1949) *In German.*

The "glass" visible region for spectrum analysis is not as restricted as is often assumed. An observation ocular is described which permits rapid identification of spectrum lines by visual methods. A comparison spectrum is thrown into the field of view from a marked spectrum on a plate taken with the same spectrograph. This test spectrum permits rapid visual comparisons to be made. The method of illuminating the test spectrum plate is described. By the use of white light either a bright or dark ground comparison spectrum can be produced according to whether a positive or a negative test plate is employed. S. TOLANSKY

535.33.072

3922. A mirror spectrograph of large relative aperture useful for infrared and ultraviolet. J. BIGAY. *C.R. Acad. Sci., Paris*, **230**, 203–5 (*Jan.* 9, 1950) *In French.*

The collimator consists of a Cassegrain system with the concave mirror, figured to correct the whole system, having diameter (d) = 160 mm and radius of curvature (ρ) varying from 1 000 to 778 mm. The camera mirror, which is also used on axis, with photographic film in the focal plane has d = 205 mm, ρ = 360 mm. Relative aperture, allowing for the central obstruction is 1·2. Prism angle is 15°. The instrument should be useful for measurements on the night sky, etc. It could be extended to infrared and ultraviolet by using gratings. G. F. LOTHIAN

535.331

3923. Forty one electron system of molybdenum–Mo II. V. RAMAKRISHNA RAO. *Indian J. Phys.*, **23**, 387–92 (*Sept.*, 1949).

Analysis of the spectrum of Mo II is extended to include the identification of nearly all the sextet terms. Detection of the inter-combinations lines led to the derivation of a connected system of atomic energy levels. About 80 lines have been newly classified. A.

535.331

3924. Excitation of forbidden rays in a high-pressure mercury arc. L. GOLDZAHL. *C.R. Acad. Sci., Paris*, **230**, 382–4 (*Jan.* 23, 1950) *In French.*

535.331

3925. On the classification of the spectrum of singly ionized uranium. J. R. MCNALLY, JR. Letter in *Phys. Rev.*, **77**, 417–18 (*Feb.* 1, 1950).

535.331

3926. Forbidden lines in the spectra of impure Hg^{198}. K. G. KESSLER. Letter in *Phys. Rev.*, **77**, 559 (*Feb.* 15, 1950).

535.332

3927. Numerical value of the Lamb shift. H. A. BETHE, L. M. BROWN AND J. R. STEHN. *Phys. Rev.*, **77**, 370–4 (*Feb.* 1, 1950).

The average excitation potential of the 2s state of H which occurs in the Lamb shift is calculated numerically and found to be 16·646 ± 0·007 Ry. This gives a theoretical value of 1 051·41 ± 0·15 Mc/s for the Lamb shift, compared with the latest experimental value of 1 062 ± 5. It is not known whether the discrepancy of 10 Mc/s can be explained by relativistic effects. Simple analytical approximations are discussed which make plausible the high value of the average excitation potential and give a good approximate value for it. A.

535.332

3928. Corrected krypton wave-lengths. T. A. LITTLEFIELD. *Nature, Lond.*, **165**, 187 (*Feb.* 4, 1950).

An arithmetical error is detected in the dispersion formula of Barrell and Sears [*Philos. Trans., A*, **238**, 1 (1939)]. With the amended formula a recalculation is made of wavelengths of 31 Kr I lines between 4 273 Å and 6 457 Å. These are given to 0·0001 Å and the wavelengths from Barrell and Sears, Kosters and Lampe, and Pérard nowhere differ by more than 0·0003 Å. The mean difference between these and the International Astronomical Union wavelengths is of the same order. S. TOLANSKY

535.332 : 537.525.8

3929. Recombination spectrum and electron density measurements in neon afterglows. R. B. HOLT, J. M. RICHARDSON, B. HOWLAND AND B. T. MCCLURE. *Phys. Rev.*, **77**, 239–41 (*Jan.* 15, 1950).

The spectrum emitted by the recombination of positive ions and electrons in the afterglow of a pulsed microwave discharge through Ne has been studied as a function of time. Simultaneous electron density measurements on the plasma were made by the cavity resonant frequency shift method, and the recombination coefficient was calculated from these data. The total radiated visible light was found to be $\propto$ the square of the observed electron density. The observation of light intensities allowed recombination measurements to be carried out at electron densities much too high to be observed directly by the cavity resonant frequency shift method. The relative intensities of several strong lines in the spectrum remained essentially constant during the afterglow, while the relative intensities of several others showed consistent changes. A.

535.333

3930. Spectroscopy and valency. VII. The periodic groups of deuteride di-atoms and di-atom ions. C. H. D. CLARK. *Proc. Leeds Phil. Lit. Soc.*, **5**, 244–52 (*Dec.*, 1949).

The periodic table of deuteride di-atoms and

di-atom ions is presented, with inclusion of fundamental frequencies calculated in 45 cases from the values of the corresponding hydrides, using the appropriate isotopic factors. Generally good agreement with experiment is found, but in a few cases where there are marked divergencies it is believed that the calculated value may be preferable. The periodicity of frequency in groups and periods is discussed in terms of mass and polarity influence factors. A.

535.333

3931. On the assignment of the triplet-singlet emission of benzene. D. P. Craig. Letter in *J. Chem. Phys.*, **18**, 236–7 (*Feb.*, 1950).

535.338.32–14

3932. The optical detection of radiofrequency resonance. M. H. L. Pryce. Letter in *Phys. Rev.*, **77**, 136–7 (*Jan.* 1, 1950).

A criticism of a paper by Bitter [Abstr. 839 (1950)] bearing the same title. The author gives an expression for the effect of a r.f. magnetic field on the Zeeman frequencies; this indicates a shift $<$ that given by Bitter's expression. On account of the high resolution necessary, detection of the effect will probably be rather difficult. G. F. LOTHIAN

535.338.332

3933. On the effects of internal nuclear motion on the hyperfine structure of deuterium. F. Low. *Phys. Rev.*, **77**, 361–70 (*Feb.* 1, 1950).

These effects are investigated, using Dirac theory for the electron and non-relativistic theory for the nucleus. Although the final result is in fair agreement with experiment, theoretical and experimental uncertainties are at present too large to allow any conclusions to be drawn concerning the possible deviation of nucleon magnetic fields from those of simple dipoles. A.

535.338.333

3934. Spectroscopic isotope shift and nuclear polarization. G. Breit, G. B. Arfken and W. W. Clendenin. Letter in *Phys. Rev.*, **77**, 569 (*Feb.* 15, 1950).

535.338.334

3935. Wave-mechanical calculation of electron collision damping constants for Fraunhofer lines. M. Rudkjobing. *Ann. Astrophys.*, **12**, 229–42 (*Oct.–Dec.*, 1949).

The damping, due to collisions of atoms or ions with free electrons, of lines in the optical wavelength region is investigated, and a formula is deduced which expresses the damping constant in terms of the temperature and the electron density. A Hartree-field form of interaction of the free electrons with the bound electrons is assumed. This damping constant depends on the phase shifts of the free electrons which are due to the change in the potential function of the atom by the line transition in question. Numerical results are given for the *H* and *K* doublet of Ca^+ and for the 4*S*–4*P* doublet of Si^{+++} at 4 100 Å. A.

535.338.4

3936. The emission spectrum of bismuth iodide. P. Tiruvenganna Rao. *Indian J. Phys.*, **23**, 379–86 (*Sept.*, 1949).

The spectrum has been photographed in a h.f. discharge using a Fuess spectrograph. A new band system between λ5900–λ5600, consisting of 4 marked groups of bands, some of which are degraded towards the red, is obtained in addition to the band system between λ4300–λ4150. The new system may correspond to the l.f. system observed in the other Bi halides. The electronic states in these halides are briefly discussed. A.

535.338.4

3937. New band systems of the TlCl molecule. P. Tiruvenganna Rao. *Indian J. Phys.*, **32**, 393–402 (*Sept.*, 1949).

The spectrum is photographed in a h.f. discharge in the first order of a 10 ft concave grating, having a dispersion of 5·7 Å/mm. 2 new systems of bands, one between λ4300–λ4150 designated here as *A*, and the other between λ4150–λ3800 designated as *B*, have been obtained in addition to the u.v. system around λ3200 analysed by Howell and Coulson [*Proc. Roy. Soc.*, **166**, 238 (1938)]. System *B* consists of about 75 bands in all, which are degraded in either direction while a few of them are headless and diffuse. System *A* consists of about 18 bands which are mostly degraded towards the red, while a few of them are violet-degraded. The vibrational analyses of these 2 systems have shown that the lower state, which is found to be common to both of them, is the upper state of the u.v. system, $^3\Pi - {}^1\Sigma^+$. Predissociation, similar to that found in the upper state of the ultraviolet system, is observed in the lower state of both the systems at $v'' = 5$. Vibrational constants have been determined for the 2 systems. The Cl isotope effect observed in some bands in the systems supports the vibrational analyses. The close proximity of the systems suggests that the upper levels may form an electronic doublet. A.

535.338.4

3938. New bands in the spectrum of thallium bromide. P. Tiruvenganna Rao. *Indian J. Phys.*, **23**, 425–9 (*Nov.*, 1949).

The spectrum is photographed in emission in a h.f. discharge in the first order of a 10 ft concave grating and also on a quartz Littrow spectrograph. About 40 new bands between λ4050–λ3800, attributed to TlBr, have been recorded which are classified into 3 v' progressions in the vibrational scheme of the main system $^3\Pi$–$^1\Sigma$. The observed Br isotope separations support the analysis. A revised analysis of the brief system of bands between λ4000–λ3950 is given. The lower state of this system is considered the same as the upper state of the main system. A.

535.338.4

3939. The complex spectrum of the diatomic molecule of chromium chloride (CrCl). V. Ramakrishna Rao and K. R. Rao. *Indian J. Phys.*, **23**, 508–16 (*Nov.*, 1949).

A band system attributed to CrCl molecule is obtained in emission in a heavy current discharge from λ6400–λ5700. The bands occur in 5 groups and appear analogous to the Mn halide bands. The system is interpreted as due to the electronic transition $^6\Pi$–$^6\Sigma$ involving high multiplicity terms. A.

535.338.4

3940. A direct proof of the existence of short-lived aromatic radicals from their emission spectra (phenyl-, benzoyl, *p*-tolyl and *p*-methylbenzoyl radicals). H. SCHÜLER AND L. REINEBECK. *Z. Naturforsch.*, **4a,** 577–81 (*Nov.*, 1949) *In German.*

The emission spectra of some 12 benzene derivatives and of benzene itself, excited in a glow-discharge [Schüler, Gollnow and Woeldicke, *Phys. Z.*, **41,** 381 (1940); Schüler and Woeldicke, *ibid.*, **42,** 390 (1941)] consist of identical bands which lie at 5 420·3, 4 985·4, 4 597·4, 4 263·0, 3 970·3 and 3 713 Å. They are attributed to C_6H_5. The intensity of the bands depends markedly on current density, and it appears that the original molecule is split in one act into an unexcited fragment and excited C_6H_5. With $C_6H_5NO_2$ and *p*. $CH_3 . C_6H_4 . NO_2$, however, it is NO_2 which is excited. Other benzene derivatives give no C_6H_5 bands. Thus the products of the process differ characteristically from molecule to molecule. C_6H_5 bands are also observed in the absorption spectra of C_6H_5CHO in the gaseous state and in hexane solution: here the radicals are produced by photolysis. Similar spectra are attributed to the $p . CH_3 . C_6H_4$ radical. The bands lie at 5 390, 4 940, 4 560, 4 235, 3 944 and 3 690 Å. Acetophenone and benzophenone give spectra which are not identical with the C_6H_5 spectrum. R. F. BARROW

535.338.4

3941. Intensity distribution of the second positive ($C^3\Pi \rightarrow B^3\Pi$) band system of molecular nitrogen. R. W. NICHOLLS. Letter in *Phys. Rev.*, **77,** 421 (*Feb.* 1, 1950).

535.338.4

3942. The band spectrum of GeF. E. B. ANDREWS AND R. F. BARROW. *Proc. Phys. Soc. Lond. A*, **63,** 185–91 (*March* 1, 1950).

Two band-systems attributed to GeF have been observed in emission from a discharge through a stream of GeF_4 vapour. Vibrational analyses of both systems have been made. A brief discussion of the results, and a comparison between the force-constants of the mono- and tetra-halides of the group IVB elements, is given. A.

535.338.4–31

3943. A note on the comparison between emission and fluorescence spectra (ultraviolet) of benzene. R. K. ASUNDI AND M. R. PADHYE. *Indian J. Phys.*, **23,** 421–4 (*Sept.*, 1949).

535.343–14/15

3944. Induced molecular vibrational and rotational absorption. L. A. WOODWARD. Letter in *Nature, Lond.*, **165,** 198–9 (*Feb.* 4, 1950).

Points out that in the presence of strong electric fields, Raman-active, but i.r. inactive, transitions are permitted to appear in the i.r. absorption by virtue of the oscillation during a vibration of the induced dipole moment. Numerical estimates indicate that the CH_4 breathing vibration should be observable at 10^4 V/cm, whereas the microwave rotational spectrum of linear non-polar molecules in a strong electric field would be almost too weak to observe.

D. H. WHIFFEN

535.343–1

3945. Infra-red absorption spectra at low temperatures. D. H. RANK AND D. W. E. AXFORD. Letter in *J. Chem. Phys.*, **17,** 1339–40 (*Dec.*, 1949).

After investigating the spectra of a number of hydrocarbons through much of the liquid and solid range, the authors conclude that there is a temperature narrowing (and sharpening) of i.r. bands within a single phase. The observation that Bjerrum's formula is followed with regard to breadth as a function of temperature is considered to be fortuitous.

A. HARVEY

535.343.

3946. New absorption lines in the arc spectrum of aluminium. W. R. S. GARTON. Letter in *Nature, Lond.*, **165,** 322 (*Feb.* 25, 1950).

535.343.1–33

3947. Schumann–Runge absorption bands in heated oxygen. W. R. S. GARTON AND M. W. FEAST. Letter in *Nature, Lond.*, **165,** 281–2 (*Feb.* 18, 1950).

535.343.1–31 : 536.46

3948. Hydrocarbon flame spectra. R. C. HERMAN AND G. A. HORNBECK. Letter in *J. Chem. Phys.*, **17,** 1344 (*Dec.*, 1949).

All the known band-systems of C_2, except the Fox–Herzberg bands, have now been observed in hydrocarbon flames. In the region 3 000–4 000 Å bands of the Schumann–Runge system of O_2 and various OH and CH bands have been identified. The possibility is raised that overlapping of the bands of these species may produce the spectrum hitherto ascribed to HCO [Vaidya, *Proc. Roy. Soc. A*, **147,** 513 (1934)]. R. F. BARROW

535.343.2–15

3949. Spectroscopic studies of rotational isomerism. V. The infra-red absorption spectra of six solid hydrocarbons in the region 1600–650 cm^{-1}. D. W. E. AXFORD AND D. H. RANK. *J. Chem. Phys.*, **18,** 51–4 (*Jan.*, 1950).

535.343.3

3950. The role of E_g^+ vibrations in the 2600-Å benzene band system. D. P. CRAIG. *J. Chem. Soc.*, 59–62 (*Jan.*, 1950).

535.343.3–14 : 537.226.3

3951. Measurements on the absorption of micro-waves. IV. Non-polar liquids. D. H. WHIFFEN. *Trans. Faraday Soc.*, **64,** 124–30 (*Feb.*, 1950).

Benzene, CCl_4 and similar symmetrical molecules which possess no permanent dipole moment are shown to have small dielectric losses which are $\propto$ the frequency in the range 0·3 to 1·2 cm^{-1}. The experimental arrangement involves the measurement of the Q of a completely filled $H_{0,1,\nu}$ cavity resonator. The observed losses and their temperature coefficient are qualitatively explained on the basis of the existence of an average dipole moment in the liquid state of about 0·1 D per molecule, which is produced by molecular distortion. A.

535.343.3–14 : 537.226.3

3952. Measurements on the absorption of micro-waves. V. The variation of relaxation time with solvent. D. H. WHIFFEN. *Trans. Faraday Soc.*, **46,** 130–6 (*Feb.*, 1950).

An account is given of an experimental method of

measuring dielectric losses at $1 \cdot 6\ cm^{-1}$. Values of the loss at this and lower frequencies are given for some 25 systems of polar molecules dissolved in non-polar solvents. The results, which in the majority of cases are accurately expressed by a single Debye loss curve, are discussed in terms of the rotational relaxation times. A.

535.343.4 : 551.593.5

The transmission of the atmosphere near ground level in u.v. and visual spectral regions. *See Abstr.* 4552

535.343.4–14

3953. Microwave spectrum of CF_3Br. A. H. Sharbaugh, B. S. Pritchard and T. C. Madison. Letter in *Phys. Rev.*, **77**, 302 (*Jan.* 5, 1950).

535.343.4–14

3954. The microwave spectrum of bromine monofluoride. D. F. Smith, M. Tidwell and D. V. P. Williams. Letter in *Phys. Rev.*, **77**, 420–1 (*Feb.* 1, 1950).

535.343.4–14

3955. New types of microwave transitions involving *l*-type doubling in OCS and HCN. R. G. Shulman and C. H. Townes. Letter in *Phys. Rev.*, **77**, 421–2 (*Feb.* 1, 1950).

535.343.4–15

3956. Vibration-rotation bands in the spectrum of methyl thiol. H. W. Thompson and C. H. Miller. *Trans. Faraday Soc.*, **46**, 22–7 (*Jan.*, 1950).

535.343.4–15

3957. The infra-red spectrum of hydrogen peroxide. P. A. Giguère. *J. Chem. Phys.*, **18**, 88–92 (*Jan.*, 1950).

The absorption spectrum of H_2O_2 vapour was examined under low dispersion in the range 2–15 μ. 4 bands were observed at 3 590, 2 630, 1 255 and 877 cm^{-1}. The spectrum of the liquid was also measured between 2 and 21 μ; it showed 5 bands at about 3 400, 2 780, 1 350, 880 and 550 cm^{-1}. The last one, which seems very diffuse, is presumably the torsional oscillation of the OH groups; as such it corresponds to a potential energy barrier of the order of 4 kcal./mole. New assignments are proposed in agreement with the model of Penney and Sutherland. A.

535.343.4–15

3958. The infra-red spectrum of $ClC^{12}N$ and $ClC^{13}N$. W. S. Richardson and E. B. Wilson, Jr. Letter in *J. Chem. Phys.*, **18**, 155–6 (*Jan.*, 1950).

535.343.4–15

3959. Line intensities and absorption for the 15-micron carbon dioxide band. L. D. Kaplan. *J. Chem. Phys.*, **18**, 186–9 (*Feb.*, 1950).

Thorndike's value [Abstr. 918 (1948)] of 560×10^{10} cycles per centimeter-atmosphere for the total intensity of the 15-μ CO_2 band is used to calculate the line intensities at one atmosphere and 300°K. Calculation of absorption results in good agreement with published absorption curves by Martin and Barker [*Phys. Rev.*, **41**, 291 (1932)] Absorption for 203 millibars and 218°K is recalculated, correcting previous errors and using better approximations. A.

535.343.4–15

3960. The infra-red CO bands as wave-number standards in the infra-red region. K. Narahari Rao. *J. Chem. Phys.*, **18**, 213–14 (*Feb.*, 1950).

The predicted positions of the lines in the (1,0), (2,0) and (3,0) rotation-vibration bands of CO are given and the possibility of using them as secondary standards is discussed. A.

535.343.4–15

3961. The infra-red spectrum and molecular constants of HF and DF. R. M. Talley, H. M. Kaylor and A. H. Nielsen. *Phys. Rev.*, **77**, 529–34 (*Feb.* 15, 1950).

New high dispersion measurements are reported. Discussion of the experimental details and analysis is given. Observed frequencies of the spectral lines, as well as observed and calculated constants, are tabulated. A.

535.343.4–31

3962. The absorption spectrum of water vapor between 900 and 2000 angstroms. J. J. Hopfield. Letter in *Phys. Rev.*, **77**, 560–1 (*Feb.* 15, 1950).

535.343.4–32

3963. The absorption spectra of methane, carbon dioxide, water vapor, and ethylene in the vacuum ultraviolet. P. G. Wilkinson and H. L. Johnston. *J. Chem. Phys.*, **18**, 190–3 (*Feb.*, 1950).

Quantitative absorption measurements were made at 30°C in a Cario and Schmidt–Ott vacuum fluorite spectrograph from 1 400–2 000 Å. Values of the atmospheric absorption coefficient, α, in the equation, $I = I_0 \exp(-\alpha x)$, ranging from 2 for CO_2 to 800 for ethylene were found. Resonance wave-lengths and oscillator strengths were calculated from absorption curves and found to be consistent with refractive index data. A.

535.343.4–32

3964. Quantitative determination of extinction coefficients in the vacuum ultraviolet: divinyl ether. A. J. Harrison, C. L. Gaddis and E. M. Coffin. *J. Chem. Phys.*, **18**, 221–3 (*Feb.*, 1950).

A method of determining the molar extinction coefficients of organic compounds in the vapour phase in the vacuum u.v. has been developed. Measurements made with a fluorite spectrograph on flowing vapour samples of divinyl ether show a precision of 3 to 8%. The absorption spectrum is completely free from fine structure. The extinction coefficient increases rapidly from a value of 10 at 42 400 cm^{-1} to a maximum of 15 900 at 49 000 cm^{-1} and decreases to a minimum value of 4 000 before beginning to rise again at 56 700 cm^{-1}. The oscillator strength of the band is 0·45. A.

535.37

3965. Measurement of the decay time of fluorescence. K. L. Rau. *Optik*, **5**, 277–86 (*Aug.*, 1949) *In German.*

By increasing the generator frequency of the Maercks–Kirchoff fluorometer [Abstr. 4094 (1938); 755 (1942)] from 6·5 Mc/s to 15·6 Mc/s the measurement of decay times as low as $0 \cdot 6 \times 10^{-9}$ sec is achieved. Decay times are given for various fluorescent materials and for a range of temperatures of the latter. G. F. J. Garlick

535.37

3966. Effect of temperature on the extinction by electric fields of the luminescence of zinc sulphides. J. MATTLER. *C.R. Acad. Sci. Paris*, **230**, 76–7 (*Jan.* 2, 1950) *In French.*

Four ZnS phosphors were investigated. Two [containing CdS + Ag and Ni], which showed no afterglow, are strongly extinguished under electric fields, the effect increasing with temperature. The third [ZnSCu] shows effects of the same order, but these do not increase with temperature. With the fourth [ZnSCu] there is hardly any effect of the field and little variation with temperature. The effects are considered as explicable on the multiple shock theory of Möglich and Rompe [Abstr. 1397 (1941)].

J. EWLES

535.37 : 537.531

X-ray irradiation of polystyrene, polythene and paraffin wax. *See Abstr.* 4114

535.371

3967. The location of dissipative transitions in luminescent systems. F. A. KRÖGER AND W. HOOGENSTRAATEN. *Physica*, **16**, 30–32 (*Jan.*, 1950).

From the temperature dependence of the decay of fluorescence in $Cd_2B_2O_5$–Mn and $CdSiO_3$–Mn it is found that the quenching of fluorescence at high temperatures is due to dissipative transitions from the excited state of the centres, whereas the quenching at low temperatures is due to dissipative transitions from higher states of a different character. For the orange Sm fluorescence of $CaWO_4$–Sm the situation is similar, the only difference being that at low temperatures the energy is not dissipated but emitted as tungstate fluorescence. A.

535.372

3968. Evidence for the part played by the host lattice and for transfer of excitation energy in CaO luminophors. J. EWLES AND C. CURRY. *Proc. Leeds Phil. Lit. Soc.*, **5**, 240–3 (*Dec.*, 1949).

535.375.5

3969. Raman tube filters. G. GLOCKLER AND J. F. HASKIN. *Proc. Iowa Acad. Sci.* **55**, 253–62 (1948).

The use of plastic filter dopes for isolating lines is discussed, and the construction of stable filters described.

535.375.5

3970. On the Raman spectra of solid CH_3Cl and CH_2Cl_2. N. C. MAJUMDAR. *Indian J. Phys.*, **23**, 465–8 (*Nov.*, 1949).

The Raman spectra at −160°c have been investigated and compared with those for the liquid and gaseous states. In the former case the frequency shifts of almost all the Raman lines are observed to diminish when the change either from gaseous to liquid state or from liquid to solid state takes place. In the latter case, however, such changes in the frequencies of the Raman lines are smaller and only those of the deformation oscillations are found to diminish considerably. No new lines in the low frequency region have been observed in the case of any of these two substances in the solid state. A.

535.375.5

3971. Observations of Raman lines of binary and ternary mixtures of acetone, methyl alcohol and carbon disulphide. M. JOERGES AND A. NIKURADSE. *Z. Naturforsch.*, **5a**, 25–34 (*Jan.*, 1950) *In German.*

535.375.5

3972. Raman spectrum of liquid ethylene and methane. D. H. RANK, E. R. SHULL AND D. W. E. AXFORD. *J. Chem. Phys.*, **18**, 116–17 (*Jan.*, 1950).

A search was made for the missing frequencies in the Raman spectrum of liquid methane. $\nu_2(e)$ was found and the harmonic of $\nu_4(f_2)$. Intense plates were obtained of the Raman spectrum of liquid ethylene. The polarizations of the lines in this spectrum were obtained. ω_6, the only missing Raman-active fundamental, was found in the position predicted. A.

535.375.5

3973. The vibrational spectra and structures of iodine pentafluoride and heptafluoride. R. C. LORD, M. A. LYNCH, JR., W. C. SCHUMB AND E. J. SLOWINSKI, JR. *J. Amer. Chem. Soc.*, **72**, 522–7 (*Jan.*, 1950).

The Raman spectra of IF_5 and IF_7 have been studied in the liquid state at room temperature or slightly below. The i.r. absorption spectra of these compounds have been measured in the vapour phase over the range 250–3 300 cm^{-1}. A.

535.375.5

3974. Erratum: Raman effect, infra-red absorption, di-electric constant, and electron diffraction in relation to internal rotation. S. MIZUSHIMA, Y. MORINO, I. WATANABE, T. SIMANOUTI AND S. YAMAGUCHI. Letter in *J. Chem. Phys.*, **18**, 234 (*Feb.*, 1950).

See Abstr. 6118 (1949).

535.375.5

3975. On the structure of germanobromoform established by means of its Raman spectrum. M. L. DELWAULLE AND F. FRANÇOIS. *C.R. Acad. Sci., Paris*, **230**, 742–3 (*Feb.* 20, 1950) *In French.*

535.375.5.03

3976. An intense light source for the excitation of Raman spectra. K. HAMMER. *Z. angew. Phys.*, **1**, 439–41 (*Aug.*, 1949) *In German.*

Constructional details and characteristics of an intense Hg lamp are given. W. R. ANGUS

535.375.5.072

3977. Direct-recording Raman spectrometer. J. J. HEIGL, B. F. DUDENBOSTEL, JR., J. F. BLACK AND J. A. WILSON. *Analyt. Chem.*, **22**, 154–9 (*Jan.*, 1950).

The instrument employs a low pressure Hg excitation source, a Young–Thollon prism monochromator, and a refrigerated RCA-C-7073B photomultiplier detector which actuates a 2-recorder system through a d.c. amplifier. The background noise level is 1% of full-scale recorder deflection when operating at maximum sensitivity. A.

535.39

3978. Coloured films of silver and quartz prepared by vacuum evaporation. Y. SOEZIMA. *J. Sci. Res. Inst., Tokyo*, **43**, 1–9 (*Sept.*, 1948).

The apparatus for evaporating quartz on to Ag mirrors, and for the determination of the transmissivity of the films thus formed are described.

Precautions to ensure the evaporation of quartz unadulterated by W (used in the heating filament) are mentioned. Experiments on Ag–quartz mixtures deposited on glass are also described. The results are presented in numerous graphs and compared with Garnett's theory [*Philos. Trans. A*, **203**, 385 (1904); **205**, 237 (1906)] with which they are shown to be in good agreement. Diagrams of the apparatus are given. R. A. WEALE

535.417

3979. Measurement of thickness of infra-red absorption cells. J. H. JAFFE AND H. JAFFE. *J. Opt. Soc. Amer.*, **40**, 53–4 (*Jan.*, 1950).

A new interferometric method is described. An accuracy of $0{\cdot}2\,\mu$ is obtained independently of the thickness. The advantages over methods previously described are that the cell plates need not be parallel and the wedge angle between them is determined with the thickness. The thickness measured is not an average value. It is possible to map out the profile of the cell. The method may be used even when the cell plates are very irregular. A.

535.42

3980. An exposition on light diffraction. W. KOSSEL. *Z. Naturforsch.*, **4a**, 506–9 (*Oct.*, 1949) *In German.*

Continues the author's earlier paper [Abstr. 4695 (1949)] on diffraction by an irregular system of rings on a glass disc. Describes the patterns obtained with a pinhole camera, when the pinhole occupies varying positions relative to the disc. G. F. LOTHIAN

535.42

3981. Light diffraction by an irregular ringplate. W. BRAUNBEK. *Z. Naturforsch.*, **4a**, 509–15 (*Oct.*, 1949) *In German.*

Deduces equations for diffraction intensities in the arrangement described by Kossel [see preceding Abstr.]. The intensity of the bright axial line falls off at increasing distances (x) from the diffraction disc as $(1 - x^2/R_1R_2)$ near and as $1/x^2$ far from the disc, where R_1, R_2 are the radii of the innermost and outermost rings on the disc. The effect of a small axial obstacle or hole some distance beyond the disc is deduced. From an expression for intensity at points off the axis the effective width (y) of the axial bright line is shown to increase very slowly with x (for R_1, R_2 equal to a few cm, the angle dy/dx is < 1 sec). G. F. LOTHIAN

535.42

3982. Diffraction of light by transparent spheres and spheroids: the Fresnel patterns. C. V. RAMAN AND S. RAMASESHAN. *Proc. Indian Acad Sci., A*, **30**, 277–83 (*Dec.*, 1949).

Describes and discusses the diffraction effects observed when a beam of light traverses a transparent sphere immersed in a liquid of slightly lower index and emerges therefrom. The two most interesting features are firstly, a concentration of intensity along the periphery of the emerging light beam which is evidently in the nature of a caustic and secondly, a concentration of intensity along the axial ray which is in the nature of a continuous focus. These two features are each accompanied by a set of interference-rings and these appear superposed on each other. Significant alterations appear in these features when the particle has a spheroidal shape. With a birefringent sphere, two sets of caustics are, in general, observed. 12 photographs illustrate the paper. A.

535.42

3983. The effect of diffraction in measurements of stray light [in an optical instrument]. M. FRANÇON AND M. CAGNET. *C.R. Acad. Sci., Paris*, **230**, 75–6 (*Jan.* 2, 1950) *In French.*

Such measurements are usually made by comparing the intensities in the two parts of the image of an object consisting of a white screen with a central black hole. The authors give an expression for the intensity of light diffracted from the screen on to the image of the hole; for useful dimensions this $\simeq 1\%$, which is comparable with the intensity of stray light in a good instrument. They state that they have confirmed experimentally the theoretical expression given. G. F. LOTHIAN

535.42 : 532.72

Diffraction micromethod for measuring diffusion coefficients in liquids. *See Abstr.* 3826

535.421

3984. On the reproduction and ruling of diffraction gratings. T. MERTON. *Proc. Roy. Soc. A*, **201**, 187–91 (*Oct.* 7, 1949).

New methods of copying ruled diffraction gratings are described. Copies of gratings can be made in hardened gelatine, and the technique of preparing such gratings and their advantages over pyroxyline replicas are discussed. Replicas on flat glass coated with gelatine can also be made from gratings ruled on cylinders. Cylinders ruled on a lathe are not sufficiently accurate, but a method is described by means of which periodic errors can be eliminated. A.

535.421

3985. The production of diffraction gratings. A. H. S. HOLBOURN. *J. Opt. Soc. Amer.*, **40**, 59 (*Jan.*, 1950).

535.43

3986. The scattering of light by light. J. C. WARD. Letter in *Phys. Rev.*, **77**, 293 (*Jan.* 15, 1950).

Dyson has shown that the divergencies which occur in quantum electrodynamics may be consistently eliminated by the use of mass and charge renormalization, to all orders of approximation. One of the processes which might be thought to give rise to divergencies and which has to be discussed is the scattering of light by light. The divergence may be isolated in a logarithmically divergent integral which is not gauge invariant, and it is conjectured that this term vanishes for reasons of symmetry as is the case to lowest order in e^2. A short formal proof is here given. P. M. DAVIDSON

535.43 : 548.0

Thermal scattering of light in quartz. *See Abstr.* 4468

535.434

3987. Light scattering arising from composition fluctuations in multi-component systems. J. G. KIRKWOOD AND R. J. GOLDBERG. *J. Chem. Phys.*, **18**, 54–7 (*Jan.*, 1950).

A general theory of Rayleigh scattering in this case is developed with the aid of the grand canonical ensemble of Gibbs. It reduces to the usual expression for systems of 2 components, but contains previously

neglected terms arising from thermodynamic interactions between solutes in systems of > 2 components. The theory is used to interpret turbidity measurements of polystyrene in benzene–methanol mixtures.

A.

535.434

3988. Light scattering in multi-component systems. W. H. STOCKMAYER. *J. Chem. Phys.*, **18,** 58–61 (*Jan.*, 1950).

A general equation is developed for the fluctuation of refractive index in multi-component systems, thus permitting the interpretation of turbidities for such systems in the absence of angular dissymmetry. Applications to several special cases of interest are presented.

A.

535.436

3989. On the molecular diffusion of light by gases and atmospheric absorption. G. DE VAUCOULEURS. *C.R. Acad. Sci., Paris,* **228,** 1485–6 (*May* 9, 1949) *In French.*

The diffusion of light by A, air and ethyl chloride agrees to < 1% with the Rayleigh–Cabannes formula.

D. H. WHIFFEN

535.514

3990. The application of polarized light to the prevention of dazzle in motor traffic. R. G. WEIGEL. *Optik*, **5,** 169–77 (*June*, 1949) *In German.*

Details are given of experiments in which polaroid sheets are used as polarizer and analyser respectively. The properties of polaroid are discussed with particular reference to its use for this application. The use of circularly polarized light is also mentioned.

H. G. JERRARD

535.514

3991. An optical interference polarizer free from loss. H. SCHRÖDER AND R. SCHLÄFER. *Z. Naturforsch.*, **4a,** 576–7 (*Nov.*, 1949) *In German.*

Brief details are given of the production of linearly polarized light in which no light is wasted. The method is to use thin, absorption-free, dielectric films capable of interference to polarize the incident light by reflection and transmission. The reflected and transmitted rays are suitably combined to produce one linearly polarized ray. [See Abstr. 301 (1948), 3916 (1949)].

H. G. JERRARD

535.514.2

3992. Polarization studies of light diffusely reflected from ground and etched glass surfaces. W. A. RENSE. *J. Opt. Soc. Amer.*, **40,** 55–9 (*Jan.*, 1950).

A theory is developed by which diffuse reflection from dielectric surfaces may be studied by measuring the polarization of the light diffusely reflected from such surfaces. Observations of the ratio of the intensities of light vibrating parallel to and perpendicular to the plane of incidence indicate that for ground and etched glass surfaces, illuminated by a collimated beam, regular reflection from small mirror-like planes, oriented at random, is responsible for much of the diffuse reflection.

A.

535.542.1

3993. Examination and calibration of a Babinet compensator. H. G. JERRARD. *J. Sci. Instrum.*, **27,** 62–6 (*March*. 1950).

Some possible errors in the construction of a Babinet compensator are given and their effects discussed from the point of view of their detection. Fu experimental details are given of the various optic methods used in examining a compensator. Vario considerations in design are mentioned and th method of calibration is described.

535.55 : 535

3994. Photoelasticity. Principles and method H. T. JESSOP AND F. C. HARRIS. *London, Cleave Hume Press Ltd.* (1950) 184 *pp.*

A book written mainly for engineers who wish t undertake practical work on stress exploration. Th elasticity theory necessary to the understanding c the principles involved, and the methods followed fo 2- and 3-dimensional stresses are given, as well a details of the "Frozen-stress" method. The optica theory is covered, including the production, behaviou and measurement of polarized light. Full details c the components of the photo-elastic bench are given and the lay-out of the optical bench is discussed Chapters are devoted to the theory of photo-elasticit and the reduction and interpretation of observations Details are given of some of the photo-elastic materials in common use such as glass, xylonite, Bakelit BT.61–893, Catalin 800, C.R.39, gelatin, Perspex an transpex. The effects of creep and edge effects ar discussed. The procedure for making models i fully described, including those models necessary fo the "frozen-stress" method. A final chapter gives series of worked examples with photographs whic illustrate in detail the various methods of interpreta tion and reduction of the observations. Appendice deal with some of the more difficult mathematica analyses, particular attention being given to the us of $\lambda/4$ plates.

H. G. JERRARD

535.55

3995. Birefringence in rubbers. D. W. SAUNDERS Letter in *Nature, Lond.*, **165,** 360 (*March* 4, 1950).

535.56

3996. A precision Faraday effect apparatus S. STEINGISER, G. J. ROSENBLIT, R. CUSTER AND C. E. WARING. *Rev. Sci. Instrum.*, **21,** 109–14 (*Feb.* 1950).

Improvements in the Faraday effect apparatus are described, indicating an attainable precision o ± 0·02% for visual measurements.

A

535.563

3997. The molecular anisotropy of the natural rotatory power of tartaric acid. M. LÉVY. *J. Phys. Radium*, **11,** 80–92 (*Feb.*, 1950) *In French.*

535.64

3998. The axiomatic development of a system of equal colour sensations. H. LITTMANN. *Optik*, **5,** 178–88 (*June*, 1949) *In German.*

A system is developed on the basis of 6 definitions (including that of stimulus), 5 axioms (including Grassmann's laws), and 8 additional propositions. The system is said to be logically self-consistent. It is trichromatic, and in agreement with observed facts, but does not appear to predict any new ones. A space-diagram is given.

R. A. WEALE

535.64

3999. The axiomatic development of a system of luminosities. H. LITTMANN. *Optik*, **5**, 234–9 (*July*, 1949) *In German.*

A system is developed on the basis of 2 definitions, 5 axioms and 3 propositions. It is said to be logically self-consistent, and its practical value to consist in the agreement between the conclusions drawn from the axioms and experimental results. No new results are predicted. R. A. WEALE

535.65

4000. Colorimetry by abridged spectrophotometry. A. C. HARDY AND F. M. YOUNG. Letter in *J. Opt. Soc. Amer.*, **40**, 59 (*Jan.*, 1950).

535.65

4001. The differential chromaticity thresholds of the standard observer. Y. LE GRAND. *Rev. Opt. (Théor. Instrum.)* **29**, 79–88 (*Feb.*, 1950) *In French.*

New primaries are derived from the C.I.E. values in accordance with equations previously given [Abstr. 6139 (1949)]. Ellipses of equal chromaticity are calculated for the standard observer on the basis of additional hypotheses, and shown to be in good agreement with MacAdam's results [Abstr. 2329 (1942)]. It is also suggested that nearly monochromatic stimuli ($\lambda < 0{\cdot}5\,\mu$) inhibit the red and green responses. This idea is applied to data on colorimetric purity and hue-discrimination. It is argued in connection with the latter that the faintness of the optimum at $0{\cdot}45\,\mu$ is due to partial inhibition: if inhibition were absent hue-discrimination in this region would be better than either at $0{\cdot}49$ or $0{\cdot}58\,\mu$. On the long-wave side of $0{\cdot}56\,\mu$ the agreement between calculated and observed results is excellent. The calculation indicates a point of inflection at $0{\cdot}68\,\mu$. Graphs are given. R. A. WEALE

535.8

4002. An improved Schlieren apparatus employing multiple slit-gratings. T. A. MORTENSEN. *Rev. Sci. Instrum.*, **21**, 3–6 (*Jan.*, 1950).

In the apparatus described, the conventional knife-edge elements are replaced by multiple slit-gratings. The main advantage gained is that larger-sized working fields can be achieved with an objective lens of given aperture. Also, in some cases, greater intensity of image illumination is obtained, and usually the over-all length of the system is reduced. A.

535.82

4003. Effect of particle size on the diffraction image in microscopy with narrow-coned, axial illumination. H. OSTERBERG AND G. E. PRIDE. *J. Opt. Soc. Amer.*, **40**, 14–22 (*Jan.*, 1950).

535.822.9

4004. Optimum properties of the phase plate in phase contrast microscopy. P. H. KECK AND A. T. PRICE. *Optik*, **5**, 31–47 (*April*, 1949) *In German.*

Optimum values of the absorption and retardation of a phase plate are shown to depend upon the properties of the object. For a point object in a homogeneous medium, with small retardation, strong absorption is necessary in the zero order diffraction direction. With an object of greater retardation, absorption in the higher diffraction orders may be necessary. Image contrast is also shown to be very dependent upon the retardation of the phase plate. Conditions are given in the form of tables and graphs, and are shown to apply to either dark or bright field illumination. Practical application of the results is briefly discussed. R. W. FISH

535.822.9

4005. Enhanced image contrast with extended objects. E. MENZEL. *Optik*, **5**, 385–94 (*Oct.*, 1949) *In German.*

Expressions for the phase contrast effect upon the image of a periodic structure are obtained. The form of the phase plate for maximum contrast is shown to depend upon the grating constants. Results are extended to non-periodic objects by Fourier integration. The theoretical intensity distribution in the case of a narrow strip of Al_2O_3 on glass, using a similar phase plate is confirmed by photometry of the observed image. R. W. FISH

535.824

4006. Uncertainty and sensitivity of compensator measurements with biological objects. I. H. H. PFEIFFER. *Optik*, **5**, 217–23 (*July*, 1949) *In German.*

The half-shade sensitivity, in double refraction measurements, is shown to depend only upon the thickness of the half-shade plate itself. The possible error in setting the compensator is calculated for various angular positions and experiment is shown to confirm the theory. Tables are given of the percentage sensitivity and the smallest discernible path differences found experimentally using the Brace–Kohler method. R. W. FISH

535.83 : 612.84

On the twilight performance of telescopes. *See Abstr.* 4567

535.833 : 522.2

4007. The theory of two new astronomical telescopes of the Schmidt type. A. COLACEVICH. *Atti Fond. "Giorgio Ronchi,"* **1**, 139–58 (*Oct.–Dec.*, 1946) *In Italian.*

Gives the theory of the first 2 orders of spherical aberration in the case of the well-known Maksutov telescope. The chromatic aberration and field curvature of this latter are then corrected by means of a weak positive lens in front of the meniscus correcter and a field lens of the conventional type. H. H. HOPKINS

535.89

4008. Emission of infra-red radiation by metallic powders. H. A. PRIME. Letter in *Research, Lond.*, **3**, 51–2 (*Jan.*, 1950).

Large peak i.r. power can be obtained by letting Cu powder flow into a spark. Results of experiments with powders of various sizes are discussed.

535.89 : 771.4

4009. Light output from a spark "point source." W. G. STANDRING AND J. S. T. LOOMS. Letter in *Nature, Lond.*, **165**, 358 (*March* 4, 1950).

HEAT 536

536.24

4010. Numerical analysis of heat flow. G. M. DUSINBERRE. *New York, Toronto, London, McGraw-Hill Book Co. Inc.* (1949) 223 *pp.*

Presents modern numerical methods for calculating

the temperature distribution and heat flux in solids for a variety of problems in the fields of steady state, transients, and cyclic transients. The methods for steady state heat flow are developed from the "relaxation" procedure of Southwell, and those for transient heat flow are based on the work of Fourier. Some of the methods presented are original; where there has been previous development of any method, for a certain type of problem, this is discussed and references given. A variety of techniques, suitable for solving varied types of problems in heat flow for one-dimensional and two-dimensional shapes, are described and the procedures are illustrated by detailed numerical calculations. Where possible, these numerical solutions are compared with the corresponding analytical solutions or the experimental results; the discrepancy is usually negligible in comparison with practical uncertainties. The procedure is described for using these numerical methods for the more complex problems where the thermal conductivity, specific heat and heat generation in the solid are functions of the temperature of the solid.

W. H. DENTON

536.26 : 533.16

Heat conductivity of steam. *See Abstr.* 3831

536.413.2

4011. Thermal expansion of fluorspar and iron pyrite. D. C. Press. *Proc. Indian Acad. Sci. A*, **30**, 284–94 (*Dec.*, 1949).

Describes measurements over the range 40°C to 300°C by a modification of Fizeau's interference method. In the case of fluorspar, the linear coefficient of expansion has been found to increase steadily from $20{\cdot}9\times10^{-6}$ to $23{\cdot}8\times10^{-6}$ in the range from 40°C to 260°C while in the case of pyrites it increases from $9{\cdot}7\times10^{-6}$ to $11{\cdot}5\times10^{-6}$ in the same range. Using the measured values of the coefficients and the known values of C_v, the Gruneisen constant γ has been evaluated for both the crystals. It is found that γ is not a constant but varies markedly with temperature.

A.

536.42

4012. Measurement of low vapour pressures. I. Filosofo, M. Merlin and A. Rostagni. *Nuovo Cim.*, **7**, 69–75 (*Jan.*, 1950) *In Italian.*

An apparatus for measuring vapour pressures between 10^{-6} and 10^{-2} atm. at temperatures between −50°C and +150°C is described. The main feature is the use of a leaf or a fibre vacuum gauge of the Knudsen type, the readings of which are independent of the gas used in the pressure range. It is shown how to avoid completely the uncertainties due to gas emission from the substance under experiment and from the walls.

A.

536.421.4

4013. The freezing point of uranium. A. I. Dahl and H. E. Cleaves. *J. Res. Nat. Bur. Stand., Wash.*, **43**, 513–17 (*Dec.*, 1949).

For U of about 99·99% purity, this was found, by an optical pyrometer, to be 1 133° ± 2°C.

A.

536.421.4

4014. The automatic recording of freezing-point curves. E. F. G. Herington and R. Handley. *J. Chem. Soc.*, 199–204 (*Jan.*, 1950).

536.423.

4015. Vapor pressures and boiling points of six API–NBS hydrocarbons. A. F. Forziati, W. Norris and F. D. Rossini. *J. Res. Nat. Bur. Stand., Wash.*, **43**, 555–63 (*Dec.*, 1949).

536.423.

4016. Mass spectrometric measurement of low vap pressures. A. W. Tickner and F. P. Lossin Letter in *J. Chem. Phys.*, **18**, 148 (*Jan.*, 1950).

536.44 : 532

4017. On the range of existence of the liquid stat J. Zernike. *Rec. Trav. Chim. Pays-Bas*, **69**, 116– (*Jan.*, 1950).

The contention that the ratio of critical and trip point temperature is approx. constant for differe substances, is shown to be erroneous. It may ha values from 1·07 to 12·3. Though some compound usually classed as one group, show about the sam value for this ratio, other related compounds ha largely different values. As a first approximation linear relation is found between this ratio and th logarithm of the triple point pressure. On th strength of this relation it is suggested that when th vapour pressure of a solid has been measured to abo 120 atm. no reversible melting is to be expecte Reasons are advanced that mercuric sulphide an paracyanogen may be cases in point.

536.4

4018. A method and apparatus for determining th ignition characteristics of plastics. N. P. Setchki *J. Res. Nat. Bur. Stand., Wash.*, **43**, 591–608 (*Dec* 1949).

536.4

4019. On the realisation of uniform movement flame propagation. H. Guénoche and N. Manso *C.R. Acad. Sci., Paris*, **230**, 726–8 (*Feb.* 20, 1950) *In French.*

536.4

4020. The mechanism of flame propagation. D. T. A Townend. *Fuel*, **29**, 64–7 (*March*, 1950).

The determination of flame speed (ignition velocit by various applications of the burner method discussed, and it is concluded that, in the light present experience, the measurement of the area the luminous inner cone is that most practicall useful; also, the measurement of "dead space provides a reliable indication of the thermal gradie ahead of a flame. The application of theories flame travel based on diffusion of active centres— H atoms in particular—is rendered obscure owing t the lack of quantitative data relating to quenchin reactions undergone by such centres. Brief referenc is made to the two-stage mechanism of combustio involving cool flames through media containin higher hydrocarbons or their derivatives.

536.4

4021. The two-fluid model for helium II. C. Gorter. *Nuovo Cim.*, **6** (*Suppl. No.* 2) 245–50 (1949)

The equations of motion of the normal and super fluids are given on the supposition that the Gibb function is non-linear in their concentrations an that there is a mutual force of friction ∝ the cub of their relative velocities. The formulae deduce lead to H. London's relations for the fountain effe and to the usual value for the velocity of secon

sound if certain proportionality laws between entropy and concentration of normal fluid are fulfilled. In discussion, F. London questions the theoretical basis of Gorter's mutual friction term on the grounds that: (1) the possibility of persistent ring currents in superconductors suggests that there can be relative motion without friction; (2) unique determination of the superfluid velocity by its normal component at a boundary would no longer be possible if mutual friction occurred between the fluids; and (3) Gorter's mutual friction term is based on the proportionality between heat flow and the cube root of the temperature gradient; this relation is fulfilled only when the superfluid velocity is $>$ its critical value, so that the two velocity fields are no longer of significance. Onsager shows that the invariant of hydrodynamic circulation is quantized in units of h/m, and suggests that the critical rate of creep of He II might be identified with the minimum rate of flow for the liquid film to lose energy by developing a vortex, and the λ point with the point at which the vortices become sufficiently numerous to form a connected tangle throughout the liquid. R. B. DINGLE

536.48

4022. Theory of superfluidity and critical velocity in helium II. V. L. GINZBURG. *Dokl. Akad. Nauk, SSSR*, **69** (*No.* 2) 161–4 (1949) *In Russian.*

In Landau's theory of superfluidity, a critical velocity v_c is obtained by taking the minimum of the quantity $\varepsilon(p)/p_y$ where $\varepsilon(p)$ is the energy of an elementary excitation flowing with momentum p_y through a slit, but this gives values of $v_c \gg$ those found experimentally. This difficulty can be avoided by introducing elementary excitations of the form $\varepsilon(p) = \pi^2\hbar^2/2\mu d^2 + p^2/2\mu$, the first term being a zero-point energy determined by the width of the slit d. It then follows that $v_c d \sim 10^{-4}$ cm²/sec in agreement with experiment. D. SHOENBERG

536.48

4023. Phase relations in He^3–He^4 solutions. B. WEINSTOCK, D. W. OSBORNE AND B. M. ABRAHAM. Letter in *Phys. Rev.*, 77, 400–1 (*Feb.* 1, 1950).

536.48

4024. Phase transition and vapor pressures of liquid mixtures of He^4 and He^3. C. J. GORTER AND J. DE BOER. Letter in *Phys. Rev.*, 77, 569–70 (*Feb.* 15, 1950).

536.48 : 539.185

Theory of slow neutron scattering by liquid helium. *See Abstr.* 4379

536.48 : 541.183

4025. Anomalous adsorption of helium at liquid helium temperatures. E. A. LONG AND L. MEYER. Letter in *Phys. Rev.*, **76**, 440–1 (*Aug.* 1, 1949).

Preliminary measurements are described of the adsorption isotherms of He^4 II on jeweller's rouge. It is concluded that the entropy of the adsorbed layers is higher than that of liquid He, and that the saturation number of atoms in the first monolayer $\simeq 4$ times that expected from the liquid density. R. B. DINGLE

536.48 : 541.183

4026. Anomalous adsorption of helium at liquid helium temperatures. W. BAND. Letter in *Phys. Rev.*, **76**, 441–2 (*Aug.* 1, 1949).

An extension of the B.E.T. theory to the case where the number of atoms in each monolayer is no longer constant gives expressions of the same form for small gas pressures. The theory agrees well with Long and Meyer's data on He^4 II [preceding Abstr.] if a co-operative energy of about 0·07 cal/mole is assumed below the transition temperature.

R. B. DINGLE

536.5

4027. Dynamic accuracy in temperature measurement. J. G. ZIEGLER AND N. B. NICHOLS. *Instruments*, **23**, 66–9 (*Jan.*, 1950).

An instrument accurate to a fraction of a degree under static conditions may be many degrees in error when the temperature is changing. Examples are given to show the magnitude of the error and how it can be determined from the "bulb lag" defined as (dynamic error)/(rate of temperature change). Compensation for the thermal lag can be obtained by introducing derivative or dynamic compensation. The modifications which must be made to a temperature transmitter are illustrated and described in detail and the results obtained are shown graphically. Single-capacity and two-capacity thermal elements are considered, the latter being a sheathed bulb with or without a special sleeve to give good contact between bulb and sheath. E. H. DOCK

536.521

4028. The use of a polarizer in the disappearing filament optical pyrometer. R. G. GIOVANELLI AND W. R. G. KEMP. *J. Sci. Instrum.*, **27**, 69–71 (*March*, 1950).

The use of a polarizer, oriented at a suitable angle, in the viewing system of an optical pyrometer is found to give complete disappearance of straight flat pyrometer filaments for apertures considerably $>$ are permissible in conventional pyrometers. Larger apertures result in higher visual resolution, and greater precision may thus be expected in measurements. A.

536.531

4029. Matching of resistance thermometers to other calibration curves. F. LIENEWEG. *Arch. tech. Messen* (*Issue No.* 167) J222–2, T115–16 (*Dec.*, 1949) *In German.*

It is shown that to match the resistance/temperature curve of one metal resistance thermometer to that of another, fixed resistances must be connected in series, parallel or series parallel. By the combination the resistance/temperature coefficient decreases so that only thermometers of larger can be matched to those of smaller resistance/temperature coefficients. One added resistance suffices for 2-point-compensation (agreement at 2 temperatures) and 2 resistances for 3-point-compensation. The results are illustrated, with full graphical and tabular information, by matching Ni and Cu thermometers to a Pt thermometer over the range $-60°$ to 200°c. To improve the linearity of the characteristic of a metal resistance thermometer of given resistance a parallel resistance must be used. S. WEINTROUB

536.532

4030. A new method for surface-temperature measurement. N. SASAKI. *Rev. Sci. Instrum.*, **21**, 1–3 (*Jan.*, 1950).

A method involving the use of a momentary contact by a thermocouple is described.

536.551 : 533.6.07

A versatile pneumatic instrument based on critical flow. *See Abstr.* 3839

536.58 : 535.34

4031. Metal cryostat with variable temperature for the study of absorption spectra. J. Mayence and B. Vodar. *C.R. Acad. Sci., Paris*, **230**, 634–6 (*Feb.* 13, 1950) *In French.*

536.627

4032. High temperature calorimetry. I. A new adiabatic calorimeter. L. D. Armstrong. *Canad. J. Res. A*, **28**, 44–51 (*Jan.*, 1950).

A new calorimeter is described for the measurement of specific heats at high temperatures, by the adiabatic method. The advantage is that the specific heat at a definite temperature can be determined by a measurement taken over a small temperature interval, with a precision of 1% or better, throughout the range 400°C to 800°C. This permits a study of specific heat anomalies in this range. A.

536.63 : 541.66

4033. Heat capacity and chemical constitution. S. Sato. *J. Sci. Res. Inst., Tokyo*, **43**, 19–30 (*Dec.*, 1948).

The influence of constitutive factors in amino-acids on values of heat capacity have been examined. The calculation of the molecular heat of organic compounds has been modified by taking into account the constitutive as well as the additive effects. Chelation and H-bonding cause little modification, but the influence of the dipolar character of the molecule is considerable. Contributions for groups and constitutive correction factors are given for several temperatures. The method used is applied to all physical states. W. R. ANGUS

536.63

4034. Size effect in low temperature heat capacities. E. W. Montroll. *J. Chem. Phys.*, **18**, 183–6 (*Feb.*, 1950).

536.631

4035. High temperature calorimetry. II. Atomic heats of chromium, manganese, and cobalt between 0° and 800°C. L. D. Armstrong and H. Grayson-Smith. *Canad. J. Res. A*, **28**, 51–9 (*Jan.*, 1950).

These have been measured by the method described in Part I [Abstr. 4032 (1950)]. The specific heat of chromium is regular from 0° to 800°C. The measurements with Mn show the sharp α–β transition at 717°C, with a latent heat of 450 cal/mole. Typical supercooling occurs on the reverse transition. Co shows an anomaly due to a gradual transition, which is known to be a change in crystal form. The new data obtained permit a comparative discussion of the atomic heats of the transition metals, Cr to Ni. All these have values $C_v > 3R$ at high temperatures. After allowing for the effects of ferromagnetism, the excess specific heats of Co and Ni are accounted for by the conduction electrons. This is not true for Cr and Mn, for which metals there must be some additional source of internal energy. It is tentatively suggested that these two metals may have antiferromagnetic transitions at temperatures above 800°C. A.

536.63

4036. Specific heats of some paramagnetic salts a temperatures near 1°K. R. J. Benzie and A. H Cooke. *Proc. Phys. Soc., Lond. A*, **63**, 213–2 (*March*, 1950).

The magnetic specific heats of Gd sulphate and c several salts of the Fe group of transition element have been measured at temperatures near 1°K by method depending on paramagnetic relaxation. Th results obtained are analysed into contributions du to magnetic dipole coupling and interaction of th magnetic ions with the electric field of the crystallin lattice. Cases in which these contributions ar insufficient to account for the observed specific heat are discussed. A

536.65

4037. On the relation between latent heat of fusion and specific heats in liquid and solid states of severa metals. M. Sato. *J. Sci. Res. Inst., Tokyo*, **44**, 77–((*Dec.*, 1949).

A comparison of observational data with a rela tionship previously deduced by Honda. [*Sci. Rep Tohoku Imp. Univ.*, 123–30 (*Sept.*, 1918)]. F. E. HOARE

536.65

4038. The heat of solution of thallous fluoride and the dissociation energy of fluorine. A. D. Caunt and R. F. Barrow. *Trans. Faraday Soc.*, **46**, 154–6 (*Feb.*, 1950).

The heat of solution of TlF to TlF (800H_2O) has been found to be exothermic to the extent of 0·5 ± 0·2 kcal/mole at 25°C. From this is derived the approximate upper limit of 45 kcal/mole for the heat of dissociation of F. A

536.658 : 541.183

4039. Heats of adsorption in molecular configuration. The pentanes on carbon black. R. A. Beebe, G. L. Kington, M. H. Polley and W. R. Smith. *J. Amer. Chem. Soc.*, **72**, 40–2 (*Jan.*, 1950).

536.662

4040. Heats of combustion and formation of some organic compounds containing oxygen. G. S. Parks, J. R. Mosley and P. V. Peterson, Jr. Letter in *J. Chem. Phys.*, **18**, 152–3 (*Jan.*, 1950).

THERMODYNAMICS 536.7/.8

536.7

4041. Co-operative free energy. E. A. Guggenheim. *Nuovo Cim.*, **6** (*Suppl. No.* 2) 181–6 (1949).

The meaning of "co-operative free energy," w, is explained, and some general statements concerning its use are made. These are illustrated by examples. Some of these relate to (1) analysis of imperfect gases and condensation, (2) thermionic emission, (3) regular solutions and order-disorder in alloys, (4) Debye's theory of ionic interaction in electrolyte solutions. L. S. GODDARD

536.7 : 539.11 : 666.1

What is glass? *See Abstr.* 4577

536.71

4042. The compressibility of, and an equation of state for gaseous isobutane. J. A. BEATTIE, S. MARPLE, JR. AND D. G. EDWARDS. *J. Chem. Phys.*, **18**, 127–8 (*Jan.*, 1950).

536.71

4043. An upper limit to the metastability of supersaturated vapors. S. W. BENSON AND E. GERJUOY. *J. Chem. Phys.*, **18**, 215–16 (*Feb.*, 1950).

A thermodynamic criterion for (mechanical) instability is applied to the condensation of supersaturated vapours. Values of the maximum thermodynamic compressibility of a vapour as a function of temperature are calculated from the Van der Waals' and Berthelot equations of state and from a newly developed, modified equation. In all cases, the upper limits predicted lie above the reported experimental values. With the exception of the Van der Waals' equation the predicted values appear much too high. The bearing of these results on the utility of the same thermodynamic criterion for estimating maximum tensile strength of liquids is discussed. A.

536.71 : 530.162

4044. The caloric and thermal equation of states in classical and in quantum statistical mechanics. J. DE BOER. *Nuovo Cim.*, **6** (*Suppl. No.* 2) 199–207 (1949).

Expressions for the equation of states of a system of identical molecules are derived, on the basis of principles of dynamics and statistical mechanics. These are compared with the expressions obtained by the method of statistical thermodynamics and are proved to be identical. L. S. GODDARD

536.75

4045. Thermodynamic properties of the surface of magnesium oxide. G. JURA. Letter in *J. Chem. Phys.*, **17**, 1335 (*Dec.*, 1949).

From results of Parks and Kelley for the heat capacity of large crystals of MgO and those of Giauque and Archibald on small crystals (probably colloidal) the surface thermodynamic properties have been computed. The calculation is approximate since the exact value of the surface area of the small crystals is unknown. The method is feasible, however, for the experimental determinations of surface tension (free surface energy) of solids. The computed values for ionic solids at 0°K are not comparable with the measured values for liquids at high temperatures, the surface energy in solids increasing with temperature. F. E. HOARE

536.75

4046. The thermodynamic functions of methyl mercaptan and dimethyl sulfide. J. L. BINDER. *J. Chem. Phys.*, **18**, 77–8 (*Jan.*, 1950).

The entropies, free energies, heat capacities and heat contents have been calculated from 298·16°K to 1 500°K at 100°K intervals. The free energies of formation have also been calculated for this temperature range based both on S gas and rhombic S as the standard states of S. A.

536.75 : 537.312.62

On the entropy of the supraconductor. *See Abstr.* 4097

536.76

4047. Thermodynamics and relaxation phenomena. J. MEIXNER. *Z. Naturforsch.*, **4a**, 594–600 (*Nov.*, 1949) *In German.*

It is shown that one can, in suitable homogeneous systems, deal with relaxation phenomena not only by kinetic methods but also by phenomenological thermodynamics. In this way a single universal statement regarding the dependence of the relaxation time on the other conditions of the system is obtained. F. E. HOARE

536.763

4048. Kinetics of heterogeneous nucleation. D. TURNBULL. *J. Chem. Phys.*, **18**, 198–203 (*Feb.*, 1950).

Consider a phase transition $\alpha \rightleftharpoons \beta$. Stable β-embryos can be retained in the temperature range of α-stability in cavities of suitable extraneous solids present in the system. Retained β-embryos may nucleate the $\alpha \rightarrow \beta$-transformation in the range of β-stability. Using these concepts a theory for the effect of thermal history upon the kinetics of phase transformations is proposed. The kinetics of heterogenous nucleation in the absence of retained embryos is discussed. A.

ELECTRICITY 537

THEORY . ELECTRONS 537.1

537.122

4049. Further data on the spin gyromagnetic ratio of the electron. A. K. MANN AND P. KUSCH. *Phys. Rev.*, **77**, 435–8 (*Feb.* 15, 1950).

The atomic beam magnetic resonance method has been used to compare the g_J values of In in the $^2P_{3/2}$ and $^2P_{\frac{1}{2}}$ states to obtain a value of this ratio. The result is $g_J(^2P_{3/2})/g_J(^2P_{\frac{1}{2}}) = 2(1{\cdot}00200 \pm 0{\cdot}00006)$. Assuming Russell–Saunders coupling, and $g_L = 1$, the spin gyromagnetic ratio of the electron may be calculated. The result is $g_S = 2(1{\cdot}00133 \pm 0{\cdot}00004)$, which is to be compared with the value $g_S = 2(1{\cdot}00119 \pm 0{\cdot}00005)$ obtained by Kusch and Foley. The discrepancy is $>$ the sum of the experimental errors. The $^2P_{\frac{1}{2}}$ state of In is believed to be free of significant perturbations which might affect the total electronic g value. However, in view of possible perturbations of the $^2P_{3/2}$ state, the agreement must be considered as very good. The present result confirms the conclusions of the previous experiment, both as to the existence of the intrinsic magnetic moment of the electron, and as to its approximate magnitude. A.

537.122: 530.145

Vacuum polarization and e^4 charge renormalisation for electrons. *See Abstr.* 3774

537.122 : 530.145

Self-stress of the electron. *See Abstr.* 3775

537.133

4050. The magnetic moment of the proton. J. DE BOER. *Ned. T. Natuurkde.*, **15**, 293–306 (*Dec.*, 1949) *In Dutch.*

An account is given of the experimental work of

Taub and Kusch [Abstr. 4750 (1949)]. Reference is made to the magnetic resonance method for determining the ratio g_p/g_J, to application of the method in the case of Cs and In, and to the calculation of the absolute value of g_p by determining absolute values of g_J. The final value of g_p is quoted as $0{\cdot}00304212 \pm 0{\cdot}000015$. E. P. WOHLFARTH

537.133 : 778.3

Range-energy relation for protons in nuclear emulsions. *See Abstr.* 4586

ELECTROSTATICS . DIELECTRICS 537.2

537.21

4051. The electrostatic field of two equal circular co-axial conducting disks. E. R. Love. *Quart. J. Mech. Appl. Math.*, **2**, 428–51 (*Dec.*, 1949).

Starting tentatively from Nicholson's infinite system of linear equations [*Phil. Trans. A*, **224**, 303–69 (1924)] a much simpler specification of the potential is developed; this involves a Fredholm integral equation the existence and uniqueness of whose solution are deducible from standard theory. The specification so obtained for the potential is shown rigorously to satisfy the differential equation and boundary conditions of the electrostatic problem. The Neumann series of the integral equation is shown to converge to its solution, so that the potential, and other aspects of the field, can be explicitly formulated and thus computed. The errors in Nicholson's process of solving his system of equations are exhibited in detail, and it is concluded that attempts to carry through that process without error cannot lead to an explicit solution. A.

537.212 : 621.317.725

4052. Electrostatic voltmeters for rockets. J. F. Clark. *Instruments*, **22**, 1007–9 (*Nov.*, 1949).

The electrostatic generator, described, consists of a rotor and stator each with 6 flat blades. The rotor blades are spun, at 5 000 r.p.m., about an axis perpendicular to the planes of the blades. The stator is coupled directly to a cathode follower with pure capacitance input and feeds in a saw-tooth voltage $\propto$ the component of the electric field along the rotor axis (the peak-to-peak amplitude of the signal is $5{\cdot}31 \times 10^{-4}$ V for an incident field intensity of 1 V/m). The signals are amplified and fed through two telemetering channels, one giving signal amplitude and the other the polarity of the field. Fields up to 10 kV/m can be measured. These instruments have been installed in Aerobee and V.2 rockets fired at White Sands. L. R. SHEPHERD

537.221 : 541.135

The contact between a solid and an electrolyte. *See Abstr.* 4424

537.226

4053. Properties of slow electrons in polar materials. H. Fröhlich, H. Pelzer and S. Zienau. *Phil. Mag.*, **41**, 221–42 (*March*, 1950).

Using a variational method, the properties of the lowest energy levels in a range $\hbar\omega$ above the ground level of the system consisting of an electron and a continuous dielectric medium has been investigated. The latter is supposed to have a single vibrational frequency $\omega/2\pi$ for long longitudinal polarization waves. The interaction between the electron and the medium then depends on 3 parameters, the static dielectric constant ε, the optical refractive index $\varepsilon_\infty^{\frac{1}{2}}$, and ω. The replacement of a crystalline lattice by a continuum is a good approximation if the length $b=(\hbar/2m\omega)^{\frac{1}{2}}$ is large compared with the lattice distance, a condition which is usually fulfilled. It is found that the energy of the ground level may be considerably (compared with $\hbar\omega$) below the energy which the system would have in the absence of interaction. The electron can be found with equal probability at any point in the medium. The average polarization of the medium therefore vanishes at any point. This does not hold, however, for the average polarization at a given distance from the electron. This quantity varies at large distances as the polarization of a point charge, but shows deviations below distances of the order b. The energy of interaction depends very little on the average velocity of the electron. Slow electrons, therefore, behave very similarly to free electrons. It follows then that self trapping in the lattice does not exist. A.

537.226 : 532.74

4054. Solvent effect on the electric moments of some amines. P. A. Geary and J. G. Miller. *J. Electrochem. Soc.*, **97**, 54–8 (*Feb.*, 1900).

The electric moments of a series of sympathomimetic amines were larger in benzene than in dioxane. The results are discussed in terms of intermolecular and intramolecular bonding, solute-solvent association, solute-solute association, and field effect. A.

537.226.1

4055. The dielectric polarisation of gaseous sulphur dioxide. R. J. W. Le Fèvre, I. G. Ross and B. M. Smythe. *J. Chem. Soc.*, 276–83 (*Jan.*, 1950).

Two sets of measurements for the above property, over the range 290–440°K, have been obtained independently and with non-identical apparatus. The two apparatuses both possess the simplicity of, but incorporate improvements upon, the oscillator-wavemeter combination of Le Fèvre and Russell. The total polarization of sulphur dioxide is represented in c.c. by $_TP = 10{\cdot}91 + 16\,164/T$, whence the dipole moment is $1{\cdot}619$ D., and the atomic polarization *ca.* $1{\cdot}4$ c.c. (or 15% of the electronic polarization). A.

537.226.1

4056. Sulphur dioxide. Its apparent dipole moment as a solute and as a pure liquid compared with the true value as a gas. R. J. W. Le Fèvre and I. G. Ross. *J. Chem. Soc.*, 283–90 (*Jan.*, 1950).

Measurements at 25°, and calculations by the Debye–Clausius–Mosotti formulae, provide moments of $1{\cdot}6_1$ D. (in benzene), $1{\cdot}6_2$ D. (in carbon tetrachloride), *ca.* $1{\cdot}4$ D. (in chloroform), and $1{\cdot}1_6$ D. (as pure liquid). A.

537.226.1

4057. The dielectric polarisations of liquid, dissolved, and gaseous paraldehyde. R. J. W. Le Fèvre, J. W. Mulley and B. M. Smythe. *J. Chem. Soc.*, 290–5 (*Jan.*, 1950).

537.226.2

4058. On the absorption of U.H.F. radio waves in organic liquids at different temperatures. S. N. SEN. *Indian J. Phys.*, **23**, 495–502 (*Nov.*, 1949).

Absorption at wavelengths ranging from 55 cm to m in acetone, methyl ethyl ketone and ether at different temperatures has been investigated. Absorption maxima have been observed for different frequencies in the case of all 3 liquids at temperatures above 0°C and it has been observed that these maxima shift to lower frequencies with the lowering of the temperatures of the liquids as observed in the case of alcohols by previous workers. A new hypothesis has been put forward to explain the occurrence of such absorption maxima. In this hypothesis it has been assumed that permanent electric moment of the molecule fluctuates as the molecule executes rotatory oscillation in the intermolecular field. A.

537.226.2

4059. Microwave absorption and molecular structure in liquids. IV. The dielectric losses and absolute dielectric constants of some non-polar liquids. W. M. HESTON, JR. AND C. P. SMYTH. *J. Amer. Chem. Soc.*, **72**, 99–101 (*Jan.*, 1950).

The dielectric constants of *n*-heptane, benzene, cyclohexane, CCl_4 and CS_2 have been measured at 77 m, 10 cm and 1·277 cm, while additional values at 3·22 cm have been obtained for *n*-heptane and benzene. The measurements at 10 cm, 3·22 cm and 1·277 cm are absolute determinations. The values are independent of frequency since the losses measured at 1·277 cm for 3 of the non-polar liquids are so low as to be negligible in their effect on the dielectric constant. The absolute dielectric constant values are linear functions of the temperature within the accuracy of the measurements. The dielectric loss values at 1·277 cm have been used to calculate extremely low moment values for *n*-heptane, benzene and cyclohexane, possibly the result of inductive effects. The calculations indicate that microwave absorption results may be used to differentiate between moment values of 0 and $0{\cdot}1\times10^{-18}$. A.

537.226.2

4060. An anomalous dielectric effect of vacuum-sputtered CaF_2 layers. E. A. LAURILA. Letter in *Phys. Rev.*, **77**, 405–6 (*Feb.* 1, 1950).

537.226.2 : 539.133

4061. Examination of the innermolecular mobility of dipole molecules in liquids by means of dielectric relaxation. E. FISCHER. *Z. Naturforsch.*, **4a**, 707–19 (*Dec.*, 1949) *In German.*

Measurements of dielectric loss in the metre-wave region show the dependence on molecular structure of the dielectric relaxation time τ. If the dipole moment μ is rigidly fixed by the atom skeleton, calculations agree well with measurements of τ. Deviations occur if one or more components of μ vary with the rotation of a polar group. The additional τ_R leads to a smaller effective τ_{eff} than the calculated value. Other innermolecular mechanisms may in special cases affect μ. Deductions for the m-wave region are discussed. J. JACOBS

537.226.2 : 621.315.612 : 621.3.011.5

4062. Preliminary note on some electrical phenomena in barium-strontium titanate. A. T. DENNISON AND R. WHIDDINGTON. *Proc. Leeds Phil. Lit. Soc.*, **5**, 191–8 (*Dec.*, 1949).

Further evidence for the ferroelectric nature of Ba–Sr titanate has been provided by a demonstration of the analogue of the magnetic Barkhausen effect, discontinuities in the polarization being heard as noise in a loudspeaker. The conductivity of the polycrystalline material has been investigated in the range 90°–150°C, and it has been shown that there exists a component of conductivity which increases with time after the application of a steady voltage to the specimen. Possible causes of this phenomenon are discussed. The dielectric constant and power factor are found to vary with time in a similar way to the conduction current, though the relative variation is smaller. It is suggested that an explanation of this may lie in Wagner's theory of anisotropic dielectrics, the variations then being consequent on the changes in the current flowing in the dielectric. A.

537.226.2 : 621.317.335.3 : 621.315.614

4063. On the measurement of the dielectric properties of fibrous materials. R. GOLDSCHMIDT. *Helv. Phys. Acta*, **22** (*No.* 6) 623–6 (1949) *In French.*

The permittivity, κ, of a mixture of two materials is given by the permittivities and proportions by volume, p_1, and p_2, of the constituents, and a factor f, which depends on the shape of the particles and the manner in which they are distributed in the mixture. In the case of papers used for capacitors and cables, a value of 6 for the permittivity of the cellulose fibre is obtained from measurements of κ, p_1, p_2, and f.

E. RUSHTON

537.226.2 : 621.365.92

4064. Frequency-selective heating at radio-frequencies. Y. ASAMI, K. HIGASI AND Y. OZAWA. Letter in *Nature, Lond.*, **165**, 195–6 (*Feb.* 4, 1950).

When a bath of transformer oil in which is placed a bulb containing water, is heated in a h.f. field, the ratio $\Delta t_2/\Delta t_1$ (where Δt_2 and Δt_1 are the increases in temperature of the water and oil) when plotted against frequency passes through a max. at about 10^7 c/s. The observed variation of $\Delta t_2/\Delta t_1$ with frequency is in good agreement with that calculated from a knowledge of the dielectric properties of the water and oil. The peak in the curve is attributed to an absorption region in the oil starting at about 10^7 c/s. E. RUSHTON

537.226.3 : 535.343.3–14

Absorption of microwaves by non-polar liquids, variation of relaxation time. *See Abstr.* 3951–2

537.228.1

4065. Seignette-electricity. B. MATTHIAS. *Helv. Phys. Acta*, **23** (*No.* 1–2) 167–70 (1950) *In German.*

A brief discussion of recent published work on the origin of seignette-electricity. H. J. H. STARKS

537.228.1 : 621.317.36

4066. An arrangement for indicating piezo-electricity of crystals. W. G. PERDOK AND H. VAN SUCHTELEN. *Philips Tech. Rev.*, **11**, 151–5 (*Nov.*, 1949).

According to the Giebe and Scheibe method the piezo-electric effect of a crystal is indicated by placing a number of fragments of crystal between two flat electrodes and connecting the latter in parallel with

the tuning circuit of an oscillator. The dips in the oscillation amplitude when the natural frequencies of the crystals are reached are made audible in a loudspeaker. With a variable-μ pentode as oscillator valve it has been possible to ensure reasonably large dips in the amplitude, whilst the sensitivity of this indication remains practically independent of the oscillation amplitude. Sensitivity is further increased by detecting the dips in the anode voltage of the oscillator with a separate amplifying valve. The tuning frequency of the oscillator is made to wobble over a small frequency range by means of a small vibrating capacitor. When a crystal frequency is reached, instead of a single click a rattling tone is heard in the loudspeaker, which is much less liable to escape notice. A.

ELECTRIC CONDUCTION : CURRENTS 537.3

537.3 : 621.385.15

4067. The statistics of electron multipliers. F. SAUTER. *Z. Naturforsch.*, **4a**, 682–91 (*Dec.*, 1949) *In German.*

It is assumed that fluctuations in multiplier gain follow an exponential distribution and a general relation between amplitudes of input and output pulses is derived. Solutions for specific cases show agreement with experiment. G. F. J. GARLICK

537.311.31

4068. Electrical conductivity of the ferro-magnetic alloy chromium-tellurium. I. G. FAKIDOV, N. P. GRAZHDANKINA AND A. K. KIKOIN. *Dokl. Akad. Nauk, SSSR*, **68** (*No.* 3) 491–2 (1949) *In Russian.*

Specific resistivity of Cr–Te alloy and its change with temperature near the stoichiometric combination (50% at. Te), the alloy consistence being 48·5% Te and 51·5% Cr is investigated. The specific resistivity changes in a magnetic field of 3–15 kilo-oersted are also measured and plotted. Both experiments yield a Curie point of 58°c, which is considerably lower than observations by previous investigators like Haraldsen, Ochsenfeld and Guillaud. A. LANDMAN

537.311.31 : 539.4.016.2

4069. The theory of the change in the conductivity of metals produced by cold work. J. K. MACKENZIE AND E. H. SONDHEIMER. *Phys. Rev.*, **77**, 264–70 (*Jan.* 15, 1950).

An attempt is made to calculate the increase in the residual electrical resistance of cold-worked metals by attributing the effect to an elastic distortion similar to that produced by the presence of edge type dislocations. A.

537.311.33

4070. On the hole current in the germanium transistor. K. LEHOVEC. Letter in *Phys. Rev.*, **75**, 1100–1 (*April*, 1949).

The principal constants of hole conduction in Ge are listed and are compared with those observed for electron currents. They include the mobilities and diffusion coefficients, thermal velocities, mean lifetime and the ranges. It is suggested that the diffusion of excitons may contribute to the current gain observed in transistors. H. K. HENISCH

537.311.3

4071. Thermoelectric power and lattice disorder semi-conductors. U. CROATTO. *Ric. Sci.*, **19**, 1324 (*Nov.–Dec.*, 1949) *In Italian.*

Measurements were made of the thermoelectric power between two samples of the same semi-conductor with different degree of lattice disorder. The substances investigated were CdO and CoO and their lattice disorder could be varied by varying the oxygen pressure in the atmosphere in which the samples were maintained. CdO has a defect of O and is therefore an *N*-type semi-conductor due to the presence of *F*-centres: its conductivity is reduced on increasing the pressure. CoO has instead an excess of oxygen, is *P*-type, and its conductivity increases on increasing the gaseous oxygen pressure. Besides confirming these views on the nature of conduction in these oxides, results proved the validity of the theoretical formula $dE/dT = \pm (R/F) \log (\sigma_1/\sigma_2)$ where the + sign applies to *N*-type conductors, R is the gas constant, F the Faraday equivalent, σ_1 and σ_2 the conductivities of the two samples.

L. PINCHERLE

537.311.3

4072. On the influence of isolated lattice perturbations on the electrical resistance of electronic semi-conductors and its temperature dependence. W. HEYWANG. *Z. Naturforsch.*, **4a**, 654–64 (*Dec.*, 1949) *In German.*

The influence of lattice imperfections on the detailed characteristics of band structure is calculated, with special reference to the observed variation of activation energy from one semi-conducting specimen to another. Meyer's rule which relates the activation energy and the concentration constant can only be accounted for if it is assumed that the mean free path is an exponential function of temperature. The positive temperature coefficient of resistivity which is sometimes observed over restricted temperature ranges can be explained by postulating the existence of more than one impurity level or by assuming that the conduction band already contains some free electrons at the absolute zero of temperature. H. K. HENISCH

537.311.3

4073. Time effects in black silicon carbide. R. L. DUDNIK AND V. I. PRUZHININA-GRANOVSKAYA. *J. Tech. Phys., USSR*, **19**, 1434–41 (*Dec.*, 1949) *In Russian.*

Investigation of the relations of current variation with time in the blocking and conducting direction. The duration of the observed time-dependent processes is incompatible with an electron-character of these processes. Pekar's rectification theory predicted durations shorter by many orders of magnitude than those actually observed. It is concluded that the time processes are not consequences of the rectification mechanism, but due to diffusion of ions or admixtures from the semiconductor into the barrier layer. The so-called "volume rectification" is due to different behaviour of the barrier layers on the two electrodes of the SiC. B. F. KRAU

537.311.33

4074. On the surface conductance of germanium. P. AIGRAIN. *C.R. Acad. Sci., Paris*, **230**, 732–3 (*Feb.* 20, 1950) *In French.*

537.311.33

4075. Erratum: Electrical properties of pure silicon and silicon alloys. G. L. PEARSON AND J. BARDEEN. Letter in *Phys. Rev.*, **77**, 303 (*Jan.* 15, 1950).

See Abstr. 6199 (1949).

537.311.33

4076. Determination of the concentrations of cation and anion vacancies in solid potassium chloride. C. WAGNER AND P. HANTELMANN. *J. Chem. Phys.*, **18**, 72–4 (*Jan.*, 1950).

537.311.33

4077. Transference numbers of solid potassium chloride with strontium chloride, potassium oxide, and sodium sulfide as additives. G. RONGE AND C. WAGNER. *J. Chem. Phys.*, **18**, 74–6 (*Jan.*, 1950).

The transference number of cations in solid KCl at 600°c has been found to be 0·88 in accordance with previous experiments of Tubandt, Reinhold and Liebold. Addition of strontium chloride causes increase of the transference number approaching unity. Addition of potassium oxide and sodium sulphide, respectively, lowers somewhat the transference number of cations and accordingly increases the transference number of anions. These results are in accordance with the Schottky disorder model, but the presence of interstitial cations apart from cation and anion vacancies cannot be ruled out.

537.311.33

4078. Energy bands and mobilities in monatomic semiconductors. W. SHOCKLEY AND J. BARDEEN Letter in *Phys. Rev.*, **77**, 407–8 (*Feb.* 1, 1950).

537.311.33

4079. Theory of impurity scattering in semiconductors. E. CONWELL AND V. F. WEISSKOPF. *Phys. Rev.*, **77**, 388–90 (*Feb.* 1, 1950).

The resistance due to scattering by ionized impurity centres is calculated by using the Rutherford scattering formula. Evaluation of the collision terms in the Lorentz–Boltzmann equation of state is made by assuming that scattering of an electron by one ion is approximately independent of all other ions. A.

537.311.33

4080. Conductivity of thin films. D. A. WRIGHT AND R. A. WEALE. Letter in *Proc. Phys. Soc., Lond. A*, **63**, 173–5 (*Feb.*, 1950).

Wright criticizes the recent analytical treatment [Abstr. 2509 (1949)] of the temperature variation of the resistivity of thin metallic films, and thinks that such films may be semi-conductors because (*a*) gas is dissolved in the crystal lattice, or (*b*) it is occluded at the crystal boundaries, or (*c*) the metal turns into a semi-conductor because of a modification of its energy-bands at reduced thicknesses. In reply, Weale points out the difference between Planck's [*Phys. Z.*, **49**, 531 (1914)] and Lovell's [*Proc. Roy. Soc. A*, **157**, 511 (1936)] expressions for the reduced electronic mean free path, and shows that his assumption that $l\rho = A + B/T$, where l is the mean free path and ρ the resistivity at T°K, and A and B are constants, implies that the film is a semi-conductor.

R. A. WEALE

537.311.33 : 621.314.63

4081. Conductivity profile of the barrier-layer of the copper-oxide rectifier from H.F. measurements and its division in the space charge regions. G. PFOTZER. *Z. Naturforsch.*, **4a**, 691–706 (*Dec.*, 1949) *In German.*

Measurements of barrier-layer resistance and capacity up to 1 Mc/s are described and discussed. It is concluded that the barrier-layer divides into three regions of differing time-constants to an a.c. field. The space-charge conditions in these regions in the barrier are explained in terms of Schottky's 1942 rectifier theory and with regard to possible lattice defects in the Cu_2O layer. C. A. HOGARTH

537.311.33 : 621.314.63 : 621.315.59

4082. Electrical properties of cadmium sulphide crystals which depend on the electrode arrangement. I. BROSER AND R. WARMINSKY. *Z. Naturforsch.*, **5a**, 62–3 (*Jan.*, 1950) *In German.*

In the course of experiments on photoconductive PbS, it was found that the application of electrodes which differ in area or in thermionic work-function can result in high rectification ratios which decrease with increasing applied voltages. A suitably spaced third electrode which is operated in the reverse direction and hence passes very little current, can serve as a control grid. Photovoltaic effects at rectifying electrodes have also been observed.

H. K. HENISCH

537.311.33 : 621.314.63 : 621.315.59

4083. Effects of electrical forming on the rectifying barriers of *n*- and *p*-germanium transistors. J. BARDEEN AND W. G. PFANN. Letter in *Phys. Rev.*, **77**, 401–2 (*Feb.* 1, 1950).

537.311.33 : 621.314.63 : 621.315.59

4084. Reverse current in germanium diodes. P. AIGRAIN. *C.R. Acad. Sci., Paris*, **230**, 62–3 (*Jan* 2, 1950) *In French*

Discrepancies between theoretical and experimental values of reverse current in Ge diodes reduced by assuming rectifying barrier to be Ge-*n* : Ge-*p* transition layer and not point contact at surface. Calculations give satisfactory values for reverse current if a suitable thickness of Ge-*n* : Ge-*p* layer is chosen. G. F. J. GARLICK

537.311.33 : 621.314.63 : 621.315.59 : 621.3.011.4

4085. Reverse current and capacitance of germanium diodes. P. AIGRAIN. *C.R. Acad. Sci., Paris*, **230**, 194–6 (*Jan.* 9, 1950) *In French.*

Calculated values from previous theory [preceding Abstr.] are compared with experimental results for Ge diode and Ge transistor of high and low resistance respectively. Respective thicknesses of Ge-*n* : Ge-*p* layers are 10^{-6} and 10^{-4} cm and capacitances 0·1 and 0·46 $\mu\mu$F. G. F. J. GARLICK

537.311.33 : 621.314.63.014

4086. D.c. characteristics of silicon and germanium point contact crystal rectifiers. II. The multicontact theory. V. A. JOHNSON, R. N. SMITH AND H. J. YEARIAN. *J. Appl. Phys.*, **21**, 283–9 (*April*, 1950).

For Part I see Abstr. 3159 (1950). Part II describes an extension of the diode theory which is able to account for the behaviour of the observed charac-

teristics. There also is described a graphical treatment for the analysis of experimental characteristics. The multicontact theory assumes that the contact potential at the metal/semiconductor surface varies from spot to spot. An exponential distribution function for contact potentials may be used to account for the observed logarithmic slopes, and the observed temperature behaviour of the characteristics may be explained by assuming that the distribution function varies with temperature in a manner dependent upon the nature of the contact. A.

537.311.33 : 621.315.59

4087. Theory of electronic semi-conductors and of derived complexes. S. TESZNER. *Bull. Soc. Franç. Elect.* (*Sér.* 6) **9**, 401–32 (*Aug.*, 1949) *In French.*

The properties of semi-conductors and rectifiers are summarized and the usual theory is outlined, the author pointing out that this theory holds largely for single crystalline specimens. The existing ideas on "derived complexes" or polycrystalline aggregates of the material are critically discussed, and the ideas developed are applied to SiC. A comparison is drawn between the properties of voltage-dependent resistors and thermistors. C. A. HOGARTH

537.311.33 : 621.315.59

4088. Conductivity in semiconductors. K. LARK-HOROVITZ. *Elect. Engng, N.Y.*, **68**, 1047–56 (*Dec.*, 1949).

A review of experimental results and basic semiconductor theory, with special reference to Ge and Si. The conductivity is limited not only by lattice scattering of charge carriers, but also by collisions with impurity centres. Scattering by polycrystalline grain boundaries also takes place, unless experiments are carried out on single crystals. The mobility of electrons in Ge has been found to be $1{\cdot}5\times10^{7}\times T^{-3/2}$ cm²/volt-sec, and that of the positive holes is somewhat smaller. Impurities present to the extent of one part in 10^6 can appreciably alter the resistivity. The distribution of Sb impurity in a Ge ingot has been investigated using a radioactive isotope of Sb and correlating measurements of the Hall effect with Geiger counter records. Impurities can be "built" into the parent lattice by bombardment with slow neutrons. Ge is thereby transmuted into Ga, which causes *P*-type conduction, and As, which causes *N*-type conduction. Sufficiently long bombardment always results in *P*-type conduction. Bombardment with heavier particles produces lattice displacements and interesting specimens can be prepared by irradiation of limited areas. In Si, Cu_2O, Se and Te, irradiation always reduces the conductivity. Optical and electrical measurements have shown that this is due to the production of deep-lying impurity levels absorbing both electrons and holes. The rather different conduction mechanism in mixed oxide semiconductors (e.g. those based on Fe_3O_4 and NiO) is also discussed. Excess and deficit conduction can be produced by appropriate substitutions for metal ions in lattice positions. H. K. HENISCH (R)

537.311.33 : 621.315.59 : 621.314.63

4089. Physical interpretation of type A transistor characteristics. L. P. HUNTER. Letter in *Phys. Rev.*, **77**, 558–9 (*Feb.* 15, 1950).

537.311.4 : 621.316.5.066.6

4090. Sliding contacts to transmit small signals. B. M. HORTON. *Rev. Sci. Instrum.*, **20**, 930–2 (*Dec.*, 1949).

Measurements have been made of r.m.s. noise voltage in the frequency range 0·5 to 200 c/s generated by contacts sliding at low speeds using 4 arrangements of contacting bodies and various materials. Hg with amalgamated probes gave the lowest noise levels. Some solid contacts operating with low friction on clean metal surfaces yielded values of generated noise $< 1\ \mu$V at a sliding speed of 35 cm/s, when two contacts were in parallel. The noise increases with speed and varies with normal force. The r.m.s. generated noise voltage of a large number of independently mounted contacts in parallel is $\propto$ (number of contacts)$^{-\frac{1}{2}}$. A.

537.311.62

4091. Anomalous skin effect in metals. R. G. CHAMBERS. Letter in *Nature, Lond.*, **165**, 239–40 (*Feb.* 11, 1950).

The r.f. resistance of Cu, Ag and Sn wires at 1 200 Mc/s has been measured from 2°K to 90°K and good agreement found with the Reuter–Sondheimer theory [Abstr. 1032 (1949)] on the assumption of completely diffuse scattering of the electrons at the walls. Evidence was found for a high resistivity surface layer in drawn wires which was not removed by annealing but could be removed by electrolytic polishing. D. SHOENBERG

537.312.5 : 621.383.4

4092. The photoconductivity of bismuth sulphide and bismuth telluride. A. F. GIBSON AND T. S. MOSS. Letter in *Proc. Phys. Soc., Lond. A*, **63**, 176–7 (*Feb.*, 1950).

Contrary to claims for an upper limit of 7 μ, it was found that Bi_2S_3 and Bi_2Te_3 respond up to only about 4 μ. The maximum centres around 7 000 Å (Bi_2S_3) and 1 μ (Bi_2Te_3). Oxidation of the latter extends the spectral sensitivity by about 1 μ and produces a second peak. The conclusion reached is that Bi photodetectors, although similar to Pb photoconductors, are inferior to the latter. W. SUMMER

537.312.62

4093. Some remarks on superconductivity. T. NEUGEBAUER. *Hungar. Acta Phys.*, **1** (*No.* 4) 28–38 (1949) *In German.*

Illustration of the difference between a diamagnetic body of zero permeability and a superconductor. The argument is extended to cover the intermediate state. Finally it is shown again that the Meissner–Oxenfeld effect cannot be deduced from infinite conductivity. H. LONDON

537.312.62

4094. No superconductivity in Na–NH_3 solutions. E. JUSTI AND G. VIEWEG. *Naturwissenschaften*, **36** (*No.* 11) 243–4 (1949) *In German.*

Confirmation of earlier results by various authors [Abstr. 3156 (1946); 878, 1212, 1866, 2941, 3201 (1947); 122 (1948)]. The specimens were in tubes of 2 mm diameter. The resistance measurements were carried out with a potentiometer using low measuring currents, the earth's magnetic field being compensated. The lowest resistivity found was

$5\times10^{-4}\,\Omega$ cm at 90° with a solution of 0·95 molar Na concentration. No persistent currents nor Meissner effect could be detected in induction measurements employing magnetic fields of 2 oersted.

H. LONDON

537.312.62

4095. Surface impedance of superconducting tin, mercury, and lead at 9 200 Mc/sec. I. Šimon. *Phys. Rev.*, **77**, 384–7 (*Feb.* 1, 1950).

Surface resistance and the change of surface reactance of these metals have been measured. The results were evaluated in terms of the penetration depth λ of London's theory and the limiting values of λ for $T = 0$ were obtained. A.

537.312.62

4096. Kinetics of the phase transition in superconductors. A. B. Pippard. *Phil. Mag.*, **41**, 243–55 (*March*, 1950).

A study is made of the influence of electromagnetic effects on the speed at which a transition can occur between the normal and superconducting states of a metal in a magnetic field, and it is concluded that these are powerful enough to be the dominant factor determining the speed. Illustrative examples include the transition of a superconducting plane slab and cylinder in a field greater than critical, the destruction of superconductivity in a wire by means of a current, and the mechanism whereby the intermediate state is established. A.

537.312.62 : 536.75

4097. On the entropy of the supraconductor. H. Itimura. *J. Phys. Soc., Japan*, **2**, 184–7 (*Nov.–Dec.*, 1947).

This is calculated for zero magnetic field using a simple model with the properties: (1) the metal contains N conduction electrons per unit volume forming a degenerate Fermi gas; (2) below the transition temperature the "condensed" part consists of p groups of electrons per unit volume each containing γ electrons; (3) on each of these "condensed" electrons there operates an attractive potential $\phi' = \phi s(1 - v^s)$ where $s = p/p_{T=0}$ and ϕ and v are adjustable constants; (4) in the counting of the number of states each condensed group is considered as a whole; and (5) the ground level of the condensed phase is higher in energy than the Fermi surface by a quantity δ. Although this model cannot explain the sharp kink in the experimental entropy-temperature curves, their general shape is reproduced if the fraction of electrons condensed at absolute zero is $\sim 2\times10^{-5}$, each group contains $\sim 6{\cdot}6\times10^{3}$ electrons, and ϕ and δ are of the order of a Bohr magnetron.

R. B. DINGLE

537.312.8

4098. Influence of a magnetic field on the conductivity of thin metallic films. E. H. Sondheimer. Letter in *Nature, Lond.*, **164**, 920–1 (*Nov.* 26, 1949).

Calculation of the combined effect of film thickness and a magnetic field perpendicular to the film on conductivity and Hall coefficient in terms of the ratio of the mean free path of the conduction electrons and of the circular orbit radius of free electrons in the magnetic field to the thickness of the film. The method is an extension of a calculation of Fuchs on the conductivity of thin films [Abstr. 1276 (1938)]. The results are in qualitative agreement with MacDonald's experiments on the magneto resistance effect in thin Na wires in a transverse field [Abstr. 3223 (1949)].

H. LONDON

537.312.8

4099. Influence of a magnetic field on the size variation of electrical conductivity. K. Sarginson and D. K. C. MacDonald. Letter in *Nature, Lond.*, **164**, 921–2 (*Nov.* 26, 1949).

Calculations similar to those of the preceding Abstr. but applying to a transverse field in the plane of the film. These too give qualitative agreement with the experiments of one of the authors [Abstr. 3223 (1949)]. H. LONDON

537.312.8 : 538.637

4100. The magneto-resistance of the alkali metals. D. K. C. MacDonald. *Proc. Phys. Soc., Lond. A*, **63**, 290–2 (*March*, 1950).

The magneto-resistive effect has been examined experimentally in the alkali metals at low temperatures. It is concluded that deviations from the free electron gas model become considerable in the case of the heavier metals, Cs and Rb. A.

537.32

4101. On the graphical determination of thermoelectric effects and relations. C. Kämmerer. *Elektrotech. u. Maschinenb.* [*EuM*] **66**, 349–52 (*Dec.*, 1949) *In German.*

The nature of thermoelectric effects in metal/metal couples is discussed, with reference to the magnitudes of thermoelectric powers of several metals against Pb, the values of Thomson coefficients, and of Peltier heats. The recent ideas on thermo-electricity based on the concept of entropy flow are developed and the results used to construct a thermoelectric diagram for several metals from which the thermoelectric properties for any couple may be calculated.

C. A. HOGARTH

ELECTRIC DISCHARGES 537.52

537.523 : 533.6.07

Use of the glow discharge as a means for measuring air flow characteristics. *See Abstr.* 3840

537.523.3

4102. The choice of suitable gap forms for the study of corona breakdown and the field along the axis of a hemispherically capped cylindrical point-to-plane gap. L. B. Loeb, J. H. Parker, E. E. Dodd and W. N. English. *Rev. Sci. Instrum.*, **21**, 42–7 (*Jan.*, 1950).

537.523.5 : 621.3.014.31

4103. The development and deionization time of heavy-current a.c. arcs. J. S. Forrest. *Brit. J. Appl. Phys.*, **1**, 10–13 (*Jan.*, 1950).

An account is given of some photographic observations made on long a.c. arcs at currents of 4 600 to

6 500 A lasting for 0·56 to 1·12 sec. The arcs were photographed with a "still" camera and also with cine cameras running at 20 and at 1 000 pictures per sec. The development of the arc is described and it is shown that the intensely luminous cloud of vapour produced by the arc commonly persists for 0·1 to 0·2 sec and in one instance was still visible 0·5 sec after the current had been interrupted. A.

537.525

4104. Negative ions in a gas discharge in Na vapour. V. M. Dukelskiĭ and E. Ya. Zandberg. *Dokl. Akad. Nauk, SSSR*, **64** (*No.* 6) 807–8 (1949) *In Russian.*

537.525

4105. Concerning W. P. Allis' criticism of my paper on Coulomb interactions in a plasma. L. Landau. Letter in *Phys. Rev.*, **77**, 567–8 (*Feb.* 15, 1950).

See Abstr. 7032 (1949).

537.525

4106. Relativistic extension of the theory of the positive column. H. Fetz. *Z. Naturforsch.*, **4a**, 627–31 (*Nov.*, 1949) *In German.*

According to the Schottky theory the distribution of charge density over a section of the positive column is given by a Bessel function of order zero. Experiments by the author [Abstr. 2881 (1942)] have shown that under certain conditions, especially with large currents and low gas pressure, marked departures from the Schottky theory appear. It is here shown that these departures are due to relativistic effects.

P. M. DAVIDSON

537.525 : 539.155.2

4107. Oxygen isotope exchange in the electric discharge. W. E. Roake and M. Dole. *J. Amer. Chem. Soc.*, **72**, 36–9 (*Jan.*, 1950).

No evidence for the exchange of O isotopes between O and water vapour could be discovered on passing the two through an electric discharge cell at low pressures and at −40° in the presence of a parallel magnetic field. However, a significant exchange was found to exist when O and CO_2 were the gases in the cell. The relation of these results to the problem of the enhanced O^{18} content of the atmosphere is discussed, and a theory for the latter is given. A.

537.525.8 : 535.332

Recombination spectrum and electron density measurements in neon afterglows. *See Abstr.* 3929

537.528.82

4108. Preliminary note on the energy distribution of electrons at the anode of a low pressure discharge. T. Smith, J. F. Tait and R. Whiddington. *Proc. Leeds Phil. Lit. Soc.*, **5**, 207–12 (*Dec.*, 1949).

The electron energy groups at the anode of a low pressure, hot cathode glow discharge have been found by magnetic analysis of the electrons passing through the anode. The photographs obtained enabled the magnitude and variation with discharge conditions of the anode fall to be found without a disturbing introduction of a probe, and also gave provisional results for the energy distribution in the positive column. Under certain conditions groups of electrons were produced within the anode fall region, and their energy variations have been investigated. A.

X-RAYS 537.531

537.531

4109. The distribution of radiation near the geometrical edge of an X-ray beam. H. E. Johns and E. K. Darby. *Brit. J. Radiol.*, **23**, 193–7 (*March*, 1950).

This has been investigated with a very small ionization chamber. The results indicate that there is a very real discontinuity at the edge of the beam. When the limiting diaphragm is placed some distance above the surface the sharp discontinuities in the isodose curves disappear, but discontinuities in slope are present. A.

537.531 : 535.312 : 539.166

4110. X-ray and gamma-ray reflection properties from 500 X units to nine X units of unstressed and of bent quartz plates for use in the two-meter curved-crystal focusing gamma-ray spectrometer. D. A. Lind, W. J. West and J. W. M. DuMond. *Phys. Rev.*, **77**, 475–90 (*Feb.* 15, 1950).

The X- and γ-ray reflection properties of the (310) planes of quartz have been investigated over the wavelength range 500 to 9 X.U. for the Laue or transmission case. The plates were inhomogeneously stressed by bending to a cylinder with a radius of 200 cm. The value of the integrated reflection coefficient was deduced from the luminosity properties of the curved-crystal spectrometer for 7 different wavelengths. The data indicate that the integrated reflection coefficient R_θ for a bent crystal varies as λ^2 over the range of wavelengths studied. This behaviour is in accord with that of a mosaic crystal. The reflection properties of the (310) planes of an unstressed crystal plate cut from the same sample were measured over the range 700 to 120 X.U. by the two-crystal spectrometer technique. These results indicate that the unstressed quartz plates behave more nearly as perfect crystals. Data are given on the integrated reflection coefficient, the peak value of Laue reflection coefficient, and the width at $\frac{1}{2}$-maximum of the diffraction curve for the unstressed case. A.

537.531 : 535.339

4111. Point-focus X-ray monochromators for low angle diffraction. J. W. M. DuMond. *Rev. Sci. Instrum.*, **21**, 188–9 (*Feb.*, 1950).

537.531 : 535.343

4112. An approximate method for the determination of intensity ratios of X-ray lines. V. N. Protopopov. *Zavodskaya Lab.*, **14**, 52–8 (1948) *In Russian.*

A pair of lines with a known intensity ratio which is unaffected by experimental conditions is registered on the film along with the lines to be measured. The intensities of the latter lines are read by interpolation or extrapolation, blackening being assumed to be a linear function of intensity. Tables are given showing the degree of error involved in this assumption at various levels of blackening.

PHOTOGRAPHIC ABSTRACTS

537.531 : 535.343

4113. Penetration and diffusion of X-rays. V. Effect of small deflections upon the asymptotic behavior. U. Fano, H. Hurwitz, Jr., and L. V. Spencer. *Phys. Rev.*, **77**, 425–6 (*Feb.* 15, 1950).

The effect of small angular deflections upon the

asymptotic trend of the X-ray intensity requires that the constant K_0 in the earlier formula $x^{K_0} \exp(-\mu_0 x)$ be replaced with the eigenvalue of an equation due to Wick. A.

537.531 : 535.37

4114. X-ray irradiation of polystyrene, polythene and paraffin wax. N. N. WINOGRADOFF. Letter in *Nature, Lond.*, **165**, 123 (*Jan.* 21, 1950).

Long irradiation (60 hr) causes increased fluorescence of polythene and paraffin wax to X-rays, but polystyrene shows reduced fluorescence both to X-rays and u.v., with a strong u.v. absorption band. It is suggested that electron traps are formed by the X-rays, below the energy of conduction bands.

F. T. FARMER

537.531 : 535.42

4115. Contribution to the study of the X-ray microscope. L. BRÚ AND M. CUBERO. *An. Real Soc. Esp. Fis. y Quim.*, **44**, 339–64 (*May–June*, 1948) *In Spanish.*

Formal analogies are pointed out between the diffraction of X-rays by crystals and that of light by two-dimensional gratings. L. PINCHERLE

537.531 : 535.434

4116. Visible light and X-ray scattering by concentrated solutions of macromolecules. G. OSTER. *Rec. Trav. Chim. Pays-Bas*, **68**, 1123–36 (*Dec.*, 1949).

The problem of X-ray scattering by macromolecules in solution is identical with that for visible light if the relative visible index of refraction of the particles $\simeq 1$. The theory of the angular distribution and decrease of transmission due to scattering by independent particles of various shapes and sizes is outlined. For a system of non-independent particles, the inter-particle interferences of the scattered wavelets must also be considered. The Zernike and Prins expression for spherically symmetric distributions is applied to a dilute system of hard spheres and to the Kirkwood idealized liquid of hard spheres. The role of repulsive forces is considered and the correlation between the angular distribution of scattering and the osmotic pressure of the system is indicated. An extension of the theory to non-spherically symmetric systems such as concentrated solutions of elongated particles is suggested. Applications are made to solutions of the rod-shaped tobacco mosaic virus. A theory of the 2-phase formation of solutions of the virus is presented and evidence of the existence of 3-dimensional virus crystals in a 2·5% solution of tobacco mosaic virus is given. A.

537.531 : 537.122

4117. Nuclear impulse in electron pair creation. G. E. MODESITT AND H. W. KOCH. *Phys. Rev.*, **77**, 175–9 (*Jan.* 15, 1950).

The nuclear impulses were studied for electron pairs produced in an air-filled cloud chamber by the continuous spectrum of X-rays from a 22 MeV betatron. Less than $\frac{1}{3}$ of the momentum transfers to the nucleus were found to consist of values $< mc$. The probability $\Phi(P_n)$ of a momentum transfer P_n was found to decrease rapidly with decreasing P_n for $P_n < mc$. A.

537.531 : 614.8

4118. X-ray protection coefficient of plate glass. C. GARRETT. *Nat. Res. Coun. Can. Publ.* (*No.* 1975) 9 *pp.* (1949).

537.531 : 621.386.1 : 621.385.833

4119. Application of electron optics to high power X-ray tubes. S. GOLDSZTAUB. *Rev. Opt.* (*Théor. Instrum.*) **29**, 101–5 (*Feb.*, 1950) *In French.*

A high intensity X-ray tube using a Law type electron gun [*Proc. Inst. Radio Engrs*, **25**, 954 (1937)] and a small hemispherical anticathode is described, this latter withstanding higher specific bombardment powers than a flat plate. Owing to the increased length of the tube it is possible to work with a molten anticathode without poisoning the emitter.

A. H. W. BECK

537.531 : 621.386.2

4120. Operation parameters of cold-cathode X-ray tubes. P. RENAUD AND P. PÉRIS. *C.R. Acad. Sci., Paris*, **230**, 79–81 (1950) *In French.*

When the pressure in a gas tube (air, O, N, H) is maintained constant by pumping against a controlled leak, the tube current decreases rapidly with time, dropping to 60% after 10 min and 25% after some hr. The discharge current is therefore a function of some as yet unknown parameter as well as of the pressure. A. J. C. WILSON

537.531 : 621.387.46 : 537.542

The cadmium sulfide X-ray detector. *See Abstr.* 4157

537.531 : 778.83

The focussing X-ray tube. *See Abstr.* 4592

CATHODE RAYS . POSITIVE RAYS 537.533/.534

537.533 : 621.384.6

4121. The electron cyclotron. P. A. REDHEAD, H. LECAINE AND W. J. HENDERSON. *Canad. J. Res. A*, **28**, 73–91 (*Jan.*, 1950).

A magnetic resonance accelerator for electrons is described, constructed on the principles suggested by Veksler. A constant magnetic field and applied frequency are employed, the frequency of the accelerating r.f. field being 2 800 Mc/s. Final energies of 5 MeV are obtained. A.

537.533 : 621.384.62

4122. On the motion of particles in a traveling wave linear accelerator. J. R. TERRALL. Letter in *Phys. Rev.*, **77**, 415–16 (*Feb.* 1, 1950).

537.533.7 : 537.56

4123. Distribution of ionization in materials irradiated by two and three million-volt cathode rays. J. G. TRUMP, K. A. WRIGHT AND A. M. CLARKE. *J. Appl. Phys.*, **21**, 345–8 (*April*, 1950).

Measurements are reported on the distribution of ionization in depth of Al produced by steady beams of 2 and 3 MeV electrons. The variation of cathode-ray current density in a plane transverse to the beam, the effect on this transverse distribution of additional Al scattering foils, and a practical method of cathode-ray dosage computation are given. A.

537.533.72

4124. A focusing phenomenon in the application of the trochoidal method to continuous β spectra. J. LAFOUCRIÈRE. *C.R. Acad. Sci., Paris*, **229**, 1005–7 (*Nov.* 14, 1949) *In French.*

The multiple focusing property previously reported [Abstr. 2506 (1950)] is discussed, and two separate focusing conditions postulated depending on the angle of emission of the particles. Methods of separating and identifying the two are given.

J. HUGHES

537.533.72

4125. Theory of a magnetic lens type beta ray spectrometer. N. F. VERSTER. *Appl. Sci. Res.*, **B 1** (*No.* 5) 363–78 (1950).

The behaviour of the electrons near the focal plane is investigated in the case of a lens type β-ray spectrometer with arbitrary field shape. Spherical and chromatic aberration constants are introduced. After some approximations a simple formula results, showing the existence of a well defined ring-shaped focus. A formula for the influence of the earth's magnetic field on the lens strength is given. The theoretical results are compared with measurements, carried out with a short lens spectrometer. A procedure for the alignment of the magnetic lens is described.

A.

537.533.72

4126. Theory of the K. Siegbahn type beta-spectrograph. G. PAQUIEN AND P. GRIVET. *C.R. Acad. Sci., Paris*, **230**, 65–7 (*Jan.* 2, 1950) *In French.*

The field of the Siegbahn lens spectrograph [Abstr. 637 (1947)] may be represented by two similar "bell" fields $H_z = H_0/(1 + z^2/a^2)$ centred respectively on source and receiver. Glaser's formulae then enable the optical properties, including primary aberration, to be calculated. In practice it is only necessary to consider $L/a = 4$, where L is the source-receiver distance. The field requirements are not less economical than for the uniform field (Tricker) type.

J. C. E. JENNINGS

537.533.72

4127. Theory of the K. Siegbahn type beta-spectrograph. G. PAQUIEN AND P. GRIVET. *C.R. Acad. Sci., Paris*, **230**, 196–8 (*Jan.* 9, 1950) *In French.*

Calculations of the constants of this type of spectrograph are discussed, for long and short magnetic lenses. A table of these constants is given for a few special cases.

J. HUGHES

537.533.72 : 621.316.721.076.7

4128. An electronic current regulator. N. F. VERSTER. *Appl. Sci. Res.*, **B 1** (*No.* 5) 358–62 (1950).

A description is given of a stabilizing circuit for a 20 kW d.c. generator, especially designed to be used with a magnetic lens β-ray spectrometer. The current is $\propto$ the setting of a 4 step decade resistor. Three series resistors in the magnet current provide a total range from 2 to 120 A. The stabilization is better than 0·1%. D.c. amplification of the error signal is accomplished by a vibrating-contact d.c. amplifier. As this amplifier is insensitive to overloading, it is possible to change the required current practically without loss of time.

A.

537.533.72 : 621.385.833

4129. Electron lenses in relativistic mechanics. J. LAPLUME. *Rev. Opt.* (*Théor. Instrum.*) **29**, 106–1 (*Feb.*, 1950) *In French.*

The relativistic equation of motion for electro trajectories in an axially symmetric field is derive The Gauss approximation is then introduced, an the equations for the cases (1) a magnetic lens (2) an electrostatic lens, are written down explicitly These clearly show the departure, at high electro speeds, from the ordinary equations. A formula i given for the relativistic correction to the focal lengt of a lens.

L. S. GODDARD

537.533.72 : 621.385.83

4130. The dipole as a diverging magnetic lens. E. PERSICO. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci Fis. Mat. Nat.*) **7**, 191–5 (*Nov.*, 1949) *In Italian.*

A magnetic dipole along the axis of an electro microscope behaves as a diverging lens of high spherical aberration. Its focal length for electron at a distance a from the axis is given approximately by $f = -(16\pi/9)a^5(1 + a^{-4})$. It is suggested tha diverging lenses of this type may be used for correct ing the spherical aberration of an ordinary magneti lens.

L. PINCHERLE

537.533.72 : 621.385.83

4131. An externally adjustable objective aperture fo an electron microscope. J. L. FARRANT AND A. J HODGE. *J. Sci. Instrum.*, **27**, 77–8 (*March*, 1950).

537.533.72 : 621.385.83

4132. Note on potentials derived from axial values in electron optics. F. BERZ. *Phil. Mag.*, **41**, 209–20 (*March*, 1950).

The determination of electrode systems which produce a precalculated distribution along the optic axis is examined. It is shown that an analytic potential distribution is completely determined when its values along any arbitrarily small interval on the axis are exactly known. If, however, the value of the potential along a finite stretch of the axis is prescribed within arbitrarily small but finite limits, this is compatible with an infinity of different potential distributions, which can be constructed without any singularity at finite distances, and which can assume prescribed values at any number of points outside the axis of symmetry.

A.

537.533.74

4133. Experimental verification of the theory of elastic scattering of fast electrons. I. I. YAMZIN AND Z. G. PINSKER. *Dokl. Akad. Nauk, SSSR*, **65** (*No.* 6) 645–8 (1949) *In Russian.*

537.533.74

4134. The cross-section for inelastic scattering of fast electrons by atoms. H. KOPPE. *Z. Phys.*, **124** (*No.* 7–12) 658–64 (1948) *In German.*

The total cross-section is considered, as this is of interest in electron microscopy, where even small-angle scattering removes electrons from the beam. To facilitate integration over all electron shells in an atom, a mean lower limit for energy transfer is introduced. With some further approximations, the inelastic scattering cross-section of a complete atom can be expressed in terms of its diamagnetic susceptibility, provided that the energy transfer is small.

For large transfers, a result due to Heisenberg is used [Abstr. 1261 (1932)], and from these two expressions a single analytic form is obtained which can be integrated over all energies to give the total cross-section. A. P. FRENCH

537.533.8

4135. Determination of the energy distribution of bremsstrahlung from 19.5-Mev electrons. H. W. KOCH AND R. E. CARTER. *Phys. Rev.*, **77**, 165–74 (*Jan.* 15, 1950).

The conventional target of a 22 MeV betatron has been replaced by a 0·005 in Pt target and the intensity spectrum of X-rays produced has been measured. The kinetic energy of the monoenergetic electrons at the time of expansion was 19·5 MeV. The X-rays were collimated and observed in the forward direction by studying the electron-positron pairs produced in a cloud chamber filled with air. About 1 300 pairs were measured. The intensity spectrum of X-rays is calculated from the pair energy distribution and is compared with the bremsstrahlung theory of Bethe and Heitler. The experimental intensity in the region of 10 MeV is found to be $>$ the theoretical value by an amount which is $>$ the statistical uncertainty of the experiment. Some details of the pair production process are given, and methods of correcting for instrumental discrimination are discussed and applied. A.

537.534

4136. Accelerators of electric particles. J. B. ELIAS. *Rev. Geofis.*, **8**, 115–32 (*April–Sept.*, 1949) *In Spanish.* Review article.

537.534

4137. A large Dempster-type double-focusing mass spectrograph. H. E. DUCKWORTH. *Rev. Sci. Instrum.*, **21**, 54–9 (*Jan.*, 1950).

The dispersion of the instrument is 2·3 mm for 1% mass difference. The theoretical resolution for a 0·001 in principal slit is 7 000 and has been experimentally realized. The performance of the instrument is illustrated by a mass spectrum showing doublets formed by singly-charged Cu and Zn and triply-charged Pt. A.

537.534

4138. Mass spectra of N_2^{14}, $N^{14}N^{15}$ and N_2^{15}. V. H. DIBELER, F. L. MOHLER AND R. M. REESE. Letter in *J. Chem. Phys.*, **18**, 156 (*Jan.*, 1950).

537.534 : 538.244.2 : 621.384.6

4139. Validity of two-dimensional design of synchrotron pole-faces. J. J. WILKINS. Letter in *Proc. Phys. Soc., Lond. A*, **63**, 177–8 (*Feb.*, 1950).

The results of 2- and 3-dimensional calculations of n values for a synchrotron magnet are given $\left(n = -\frac{r}{H_z}\frac{\partial H_z}{\partial r}\right)$. It is concluded that, where good magnet steel is used, the variation of n with r may be predicted with sufficient accuracy by 2-dimensional electrolytic tank measurements. T. G. PICKAVANCE

537.534 : 621.384.6

4140. A general theory of the betatron. H. HINTERREGGER. *S.B. Öst. Akad. Wiss., Abt. IIa*, **156** (*No.* 5–6) 299–334 (1948) *In German.*

A betratron is considered in which the magnetic field is not separable, i.e. not the product of a time-dependent and space-dependent part. The stable orbit of the separable field is replaced by an optimum orbit, the position of which may vary throughout the acceleration period. The application of an optimum orbit which varies during injection or extraction is discussed. W. I. B. SMITH

537.534 : 621.384.6

4141. Design study for a three-Bev proton accelerator. M. S. LIVINGSTON, J. P. BLEWETT, G. K. GREEN AND L. J. HAWORTH. *Rev. Sci. Instrum.*, **21**, 7–22 (*Jan.*, 1950).

A design study is presented for a proton synchrotron (Cosmotron) to accelerate protons to energies of the order of 3×10^9 V. Protons are injected from a 4 MeV Van de Graaff machine. They are deflected electrostatically into a racetrack orbit including 4 quadrants of 30 ft radius of curvature, and 4 straight sections 10 ft long. The energy gain per revolution supplied by the r.f. system will be about 1 000 eV. Acceleration will continue to 1.0 sec to a final energy $\simeq 3$ BeV. Construction of this machine is now in progress. A.

537.534 : 621.384.6

4142. The Harwell cyclotron. T. G. PICKAVANCE, J. B. ADAMS AND M. SNOWDEN. *Nature, Lond.*, **165**, 90–1 (*Jan.* 21, 1950).

A new frequency-modulated cyclotron produces about 0·5 μA of 180 MeV protons. The magnet (110 in pole diameter, 12 in gap) weighs 740 tons and produces 16 500 gauss with 355 kW. 5·5 kV peak voltage is applied to a single "dee," from a grounded grid oscillator modulated mechanically at $\sim$ 80 c/s over the range 26·5–20 Mc/s. The "dee" is biased 500 V d.c. to prevent discharges. The final orbit radius is 50 in. The vacuum pumps (10 000 l/sec) produce a pressure $< 10^{-5}$ mm Hg in the 12 000 l accelerating system. The machine is underground, for neutron shielding, and Bi fission measurements show that a Cu target gives $\sim 10^{10}$ neutrons/sec/unit solid angle with energy $>$ 50 MeV. Proton irradiations can be made on an adjustable probe, and neutron experiments are to be done with counters, photographic emulsions and cloud chambers. T. G. PICKAVANCE

537.534 : 621.384.6

4143. Double orbit in the 30 MeV synchrotron. J. D. LAWSON. Letter in *Nature, Lond.*, **165**, 109–10 (*Jan.* 21, 1950).

A spurious pulse of electrons appearing earlier than the main beam pulse in a 30 MeV synchrotron, and with nearly the same energy, has been interpreted in terms of a resonance between the second harmonic of the radial oscillations and the orbital frequency. At $n = 0{\cdot}75$, where $n = -d(\log H)/d(\log, r)$ the radial oscillation frequency is $\frac{1}{2}$ the orbital frequency; when $n \simeq 0{\cdot}75$, the position of maximum electron amplitude will slowly precess. The radial oscillation frequency depends on the amplitude and it is shown that a small circumferential inhomogeneity might produce a forcing term exactly twice this frequency and that some electrons, produced with a range of amplitudes at injection, can damp down to an oscillation of fixed amplitude about the equilibrium orbit. After the r.f. has been switched off some of these electrons can hit the target before those in the

equilibrium orbit. Tests, made by introducing artificial magnetic inhomogeneities, supported this hypothesis. T. G. PICKAVANCE

537.534.08 : 621.317.71

4144. Integrator for small beam currents. T. A. HALL, S. D. WARSHAW AND J. DORSEY. *Rev. Sci. Instrum.*, **21**, 177–8 (*Feb.*, 1950).

A simple circuit is described which integrates approximately beam currents of 10^{-14} A or larger. It consists of a d.c. amplifier, which converts the current into a voltage signal, and a voltage integrator circuit. Integration is approximate primarily because of slow circuit response to fluctuations; under usual conditions of h.v. accelerator work, accuracy $\simeq$ 1 to 5%. A.

537.534.74 : 539.152.1

Proton-proton scattering and the triplet range of nuclear force. *See Abstr.* 4265

537.538 : 621.385.032.216

4145. The potential distribution in pulsed oxide-coated cathodes and its consequences for the velocity distribution of the emitted electrons. R. LOOSJES, H. J. VINK AND C. G. J. JANSEN. Letter in *J. Appl. Phys.*, **21**, 350–1 (*April*, 1950).

See Abstr. 1864 B (1950).

DISCHARGE TUBES . COUNTERS 537.54

537.542

4146. Amsterdam conference on ion sources. C. J. ZILVERSCHOON. *Nature, Lond.*, **165**, 309–10 (*Feb.* 25, 1950).

Short report of the conference, held Nov. 15–16, 1949.

537.542

4147. The Geiger-Müller counter. L. F. CURTISS. *Circ. U.S. Bur. Stand., Wash.* (*No.* 490) 25 *pp.* (1950).

A brief description of the basic mechanism of G.M. counters. Examples of the various forms of counters are illustrated. A discussion of some of the electronic circuits used is included. Extensive bibliography. A.

537.542

4148. Dead-time theory and technique. H. DEN HARTOG and F. A. MULLER. *Physica*, **16**, 17–29 (*Jan.*, 1950).

A theory is developed of the operation of G.M. counters at extremely high counting rates. With this type of operation, pulses follow each other in a far more rapid succession than would correspond to the recovery characteristic at a low counting rate. The theory is applied to one specific instance, and data are collected. Also, a novel circuit is described avoiding the complications associated with high counting rates, such as dead-time correction, reduction of average pulse size and reduction of counter efficiency. The circuit shown controls the insensitive periods of the counter, and the fraction of time of counter sensitivity is shown on a meter. A.

537.542

4149. Temperature effects in the spurious discharge mechanism of parallel plate counters. F. L. HEREFORD. Letter in *Phys. Rev.*, **77**, 559–60 (*Feb.* 15, 1950).

537.542 : 621.317.61

4150. An electronic instrument for rapidly tracing the plateaux of G–M counters. G. H. VAZE. Letter in *Rev. Sci. Instrum.*, **20**, 746–7 (*Oct.*, 1949).

Briefly describes, and gives a block diagram of, a circuit which enables counter characteristics to be plotted in a few seconds. The results are displayed on a c.r.o. screen (sweep time varying from 0·2 to 5 sec), and representative results are reproduced, showing the effect of varying the counting rate on the smoothness of the curves, etc. For example, a counting rate of $\sim$ 250/sec gave appreciable fluctuations in the displayed plateau characteristic, but these were negligible with a counting rate of $\sim$ 1 000/sec. J. D. CRAGGS (R)

537.542

4151. Small probing Geiger–Müller counters. C. V. ROBINSON. *Rev. Sci. Instrum.*, **21**, 82–4 (*Jan.*, 1950).

Experiments with argon/ethyl acetate mixture in small counters are described. Details of construction are given for two designs of brain probing counters of 3- and 2-mm diameters. A.

537.542

4152. The re-absorption of fluorescence radiation produced in an ionization chamber or counter. H. TELLEZ-PLASENCIA AND P. THÉRON. *J. Phys. Radium*, **11**, 93–6 (*Feb.*, 1950) *In French.*

The paper deals with the importance of the fluorescence radiation produced when X-rays are absorbed in a detecting device, such as an ionization chamber or a Geiger counter, and with the calculation of the fraction of the resonance radiation reabsorbed in the detector. The effect is sometimes important in the case of guard-ring ionization chambers. J. D. CRAGGS

537.542

4153. Proportional counters with high amplification factors. E. FÜNFER AND H. NEUERT. *Naturwissenschaften*, **37** (*No.* 1) 20–1 (1950) *In German.*

A brief note which points out that the amplification factor of most proportional counters is usually $\gtrsim 10^3$, and which then describes work with $CH_2(OCH_3)_2$ fillings. With this gas, amplification factors of $> 10^6$ for proportional counting of α-particles were obtained and curves relating pulse size to counter voltage are given for $CH_2(OCH_3)_2$, CH_3OH, and A/C_2H_5OH fillings. J. D. CRAGGS

537.542

4154. A general purpose ionization meter. S. J. WYARD. *Brit. J. Radiol.*, **23**, 101–6 (*Feb.*, 1950).

The use of multiple range switching and a cathode follower output stage in a d.c. feed-back amplifier gives increased versatility, and makes the instrument applicable to many radiological measurements. F. T. FARMER

537.542 : 539.16.08

4155. An improved neon-lamp radium detector. R. G. GOSLING. *Brit. J. Radiol.*, **23**, 198–201 (*March*, 1950).

It is shown that an ordinary commercial Ne-lamp

can be used as a γ-ray counter, with a working voltage of about 170 V and with a plateau around the value of 15 V. This leads to a simple, compact and sensitive radium detector. A.

537.542

4156. Effect of light on a diamond conduction counter. R. K. WILLARDSON AND G. C. DANIELSON. Letter in *Phys. Rev.*, **77**, 300–1 (*Jan.* 15, 1950).

Measurements were made on the use of u.v. light to remove the accumulation of space charge field. The counting rate due to a Co^{60} γ-ray source was decreased on irradiating with u.v., but on removing the light source the counting rate increased to a constant value which it maintained indefinitely for saturation fields. The same counting rate is obtained even when the γ-ray source is removed for several hr and then replaced, but lower field strengths temporarily lower the counting rate. A minimum field strength exists for activation to take place. A tentative explanation is given. J. HUGHES

537.542 : 537.531 : 621.387.46

4157. The cadmium sulfide X-ray detector. R. FRERICHS. *J. Appl. Phys.*, **21**, 312–17 (*April*, 1950).

Reduced to the same solid angle the sensitivity of the detector is of the same order as the photomultiplier. As the internal amplification of the primarily released electron currents in CdS is of the order 10^3 to 10^4 compared with the amplification in the multiplier tube of 5×10^5 the conversion process of X-ray quanta in slow electrons in CdS must be more efficient than the corresponding processes in the combination crystal phosphor screen photomultiplier. Calibration curves show a linear relation between photo-current and intensity of X-rays at low irradiation levels. At high irradiation saturation effects occur. Oscilloscope curves of the response at 50 X-ray pulses per second are given. At strong irradiation the photo-current over a long time increases in a completely reversible way. X-ray intensities as low as 150 quanta CuK_α per second are registered with a circuit employing a WL 759 trigger tube. A.

537.542

4158. Counting of fundamental particles and quanta with electron multiplier and phosphor screens. E. FÜNFER. *Z. Naturforsch.*, **4a**, 672–82 (*Dec.*, 1949) *In German.*

Counting characteristics of a 1P21 photomultiplier and phosphor screen are studied. A ZnS phosphor suffices for α-particle detection having 100% counting efficiency. For β- and γ-rays naphthalene and anthracene crystals are used. Cooling increases the counter efficiency to 10 × that of G–M system. Pulse decay time is measured by c.r.t. (Anthracene, 10^{-7} sec). Spread in pulse heights is due to spread in numbers of photoelectrons and in number of quanta from phosphor per particle.

G. F. J. GARLICK

537.542

4159. The scintillation counter. II. The preparation of transparent inorganic phosphor screens. L. B. ROBINSON, C. S. COOK AND D. E. JEFFERSON. Letter in *J. Chem. Phys.*, **18**, 148–9 (*Jan.*, 1950).

537.542

4160. The response of the anthracene scintillation counter to monoenergetic electrons. J. I. HOPKINS. Letter in *Phys. Rev.*, **77**, 406–7 (*Feb.* 1, 1950).

537.542

4161. Coincidence experiments for noise reduction in scintillation counting. H. KALLMANN AND C. A. ACCARDO. *Rev. Sci. Instrum.*, **21**, 48–51 (*Jan.*, 1950).

A method is described which permits discrimination between noise pulses and pulses of small light flashes. The arrangement consists of 3 multipliers facing the 3 faces of one and the same crystal. One multiplier acts on the Y axis, another on the X axis and the third one on the Z (intensity) axis of an oscilloscope. Light flashes induce pulses in all multipliers simultaneously, whereas noise-pulses occur at random and produce triple-coincidence pulses only very rarely. Triple coincidences are easily recorded with the scope. Pictures are presented illustrating the operation of the arrangement. The original noise being of the order of 3 000/sec was dropped to 1 noise pulse in 3 sec.

537.542 : 539.16.08

4162. Measurements of the energy of beta- and gamma-rays with a scintillation counter. S. A. E. JOHANSSON. Letter in *Nature, Lond.*, **165**, 396 (*March* 11, 1950).

537.542

4163. The fundamentals of the α-particle spark [Greinacher] counter. R. RICAMO. *Nuovo Cim.*, **7**, 36–54 (*Jan.*, 1950) *In Italian.*

An experimental study of the effect on the efficiency of the counter of the diameter of the wire, the distance between the electrodes, and the importance of the corona loss. L. PINCHERLE

537.542

4164. Statistics of counting. W. C. ELMORE. *Nucleonics*, **6**, 26–34 (*Jan.*, 1950).

The statistical theory of a random sequence of events, one of which is chosen as the origin in time. The probability density for a single event and for the mth event are derived, together with the Poisson distribution for the probability that m events, with average frequency n, occur in a time interval T. The Laplace transformation is used to derive the moments of the probability density functions and this method is extended to the calculation of losses in the counting of random events in different systems. The cases examined include: a counting circuit having a single non-extended resolving time (i.e. one in which a pulse occuring during the deadtime does not extend it); a circuit having a single extended resolving time; a circuit having a non-extended resolving time T_1 at the input and a non-extended resolving time T_2 following a scale of m (the case of a fast pre-scaler—a nomograph is constructed to give fractional counting loss); a circuit having a non-extended resolving time T_1 at input and extended resolving time T_2 following the scale of m (the case of a scalar operating a message register).

L. R. SHEPHERD

537.542 : 539.16.08

4165. Electrical apparatus giving automatically the distribution in time of nuclear events (particle emission). J. THIBAUD AND R. CHÉRY. *C.R. Acad. Sci., Paris*, **230**, 83–5 (*Jan.* 2, 1950) *In French.*

An input pulse from an α-particle ionization

chamber is used to deflect vertically and brighten the spot of a c.r.t. in such a way that the deflection of the recorded spot indicates the time elapsed since the previous event: the horizontal deflection is provided by a frequency-controlled linear time-base. The distribution in time of α-particles from Po was random. A. O. STANESBY

537.542

4166. Note on the detection of coincidences and short time intervals. R. HOFSTADTER AND J. A. MCINTYRE. *Rev. Sci. Instrum.*, **21**, 52–3 (*Jan.*, 1950).

A flexible method of detecting coincidences and short time intervals has been devised in which a photomultiplier tube views the screen of a cathode-ray tube. By using one pulse as initiator of a sweep and the other in vertical presentation, coincidences can be observed in a fixed portion of the screen while the remainder of the screen is masked off. In present use the method is limited only by the pulses available (5×10^{-8} sec). The method appears to be capable of extension to time intervals of the order of 9×10^{-10} sec or smaller. A.

537.542 : 621.318.572

4167. A coincidence circuit with a resolving time of up to 2×10^{-9} secs., and the use of multipliers as counters. K. P. MEYER, E. BALDINGER AND P. HUBER. *Helv. Phys. Acta*, **23** (*No.* 1–2) 121–42 (1950) *In German.*

The coincidence circuit is a double-triode cathode follower circuit with a common cathode load, and is used in conjunction with two 16-stage electron multipliers with Ag–Mg sensitive surfaces. The amplitude of the pulses from the multiplier, the multiplication, and the existence of a plateau are discussed. The efficiency of the multipliers is determined for various γ-ray energies, and compared with that of a G.M. tube with a Bi wall. The resolving time is measured using rectangular pulses from the discharge of various lengths of charged coaxial cable. Measurements were made of the width of the pulses from the multiplier, and the limitations to the resolving time of the whole counting system discussed. J. HUGHES

537.542

4168. A nomogram for G–M counter resolving-time corrections. H. L. ANDREWS. *Rev. Sci. Instrum.*, **21**, 191–2 (*Feb.*, 1950).

537.542

4169. A reprojection method for studying cloud-chamber photographs. D. A. BROMLEY AND R. D. BRADFIELD. *Rev. Sci. Instrum.*, **21**, 190–1 (*Feb.*, 1950).

IONIZATION . THERMIONICS 537.56/.58

537.581

4170. Determination of the absolute ionization coefficient on the surface of heated wolfram. U. ARIFOV, A. KH. AYUKHANOV AND V. M. LOVTSOV. *Dokl. Akad. Nauk, SSSR*, **68** (*No.* 3) 461–3 (1949) *In Russian.*

The experimental determination of the absolute surface ionization coefficient is described, the W wire is stretched inside 3 cylinders in line, the outer one being used for screening and guard purposes, the middle one for oscillographic observation of ion currents. The coefficient can be obtained from values of ion currents for positive and negative polarity of the wire in relation to the collector electrode; this change must be rapid because high temperature (> 1 200°K) leads to fast evaporation of retarded ions. Hence square waves of 10^{-2} sec duration are employed. Oscillograms for varying temperatures are shown and interpreted; the results confirm earlier theoretical conclusions of Langmuir and Copley and Phipps. A. LANDMAN

537.583

4171. Measurement of the variation of work function of silicon with temperature. B. J. ROTHLEIN AND P. H. MILLER, JR. Letter in *Phys. Rev.*, **76**, 1882 (*Dec.* 15, 1949).

537.583

4172. Thermionic emission of thin films of alkaline earth oxide deposited by evaporation. G. E. MOORE AND H. W. ALLISON. *Phys. Rev.*, **77**, 246–57 (*Jan.* 15, 1950).

Monomolecular films of BaO or SrO were deposited by evaporation on clean W or Mo surfaces with precautions to eliminate effects caused by excess metal of the oxide or by heating. Thermionic emissions of the same order of magnitude as from commercial oxide cathodes have been obtained from these systems. The results can be explained qualitatively by considering the adsorbed molecules as oriented dipoles. Although the results may suggest a possible mechanism for a portion of the emission from thick oxide cathodes, there are serious obstacles against such thin film phenomena as a complete explanation. A.

537.583 : 621.385.032.216

4173. Activation phenomena with thoria cathodes. O. A. WEINREICH. Letter in *J. Appl. Phys.*, **20**, 1256 (*Dec.*, 1949).

Three states of activity are distinguished: (1) Low activation, freshly made cathode at ~1 200°K; (2) Higher activity obtained after flashing to 1 700°K; (3) Highest activity obtained by flashing to 2 600°K; ionic or electron bombardment, or exposure to evaporation products from an activated thoria cathode. In state 3, the emission is about 0·7 A/cm² at 1 700°K, and 0·2 A/cm² in state 2; the emission is unstable and readily poisoned by O_2 and decays with normal emission. It is also sensitive to the anode material. State 3 differs from state 2 by having a higher A value, ϕ being virtually unchanged.

A. H. W. BECK

537.583 : 621.385.1.032.216

4174. Comparison between the electron temperature and the thermodynamic temperature of oxide cathodes. R. CHAMPEIX. *C.R. Acad. Sci., Paris*, **230**, 64–5 (*Jan.* 2, 1950) *In French.*

Compares the temperature measured from the retarding field characteristic with the pyrometer temperature. The "electronic" temperature is 2–40% > the pyrometer value, the difference being $\propto$ (temperature)$^{-1}$. The difference is greater after activation than before, and depends on the anode

geometry. If T = electron temperature, θ = pyrometer temperature, $T = A\theta + b$. $(A < 1)$.

A. H. W. BECK

COSMIC RAYS 537.591

537.591 : 550.37

Cosmic radiation and the maintenance of a potential gradient in the atmosphere. *See Abstr.* 4504

537.591.1

4175. On the solar origin of cosmic radiation. II. H. ALFVÉN. *Phys. Rev.*, **77**, 375–9 (*Feb.* 1, 1950).

Teller–Richtmyer's theory of the origin of cosmic radiation [Abstr. 4852 (1949)] is discussed. It is found that the magnetic field ("trapping field"), which they postulate in order to explain the isotropy of cosmic radiation, must be toroidal and have an extension of about 0·1 light year. A field of this type may be produced by the motion of the solar system relative to interstellar matter. The theory gives the energy spectrum and total intensity of cosmic radiation. A.

537.591.1

4176. On the energy spectrum of heavy nuclei in primary cosmic radiation. M. S. VALLARTA. Letter in *Phys. Rev.*, **77**, 419–20 (*Feb.* 1, 1950).

537.591.15

4177. On the theory of air showers initiated by secondary soft rays. S. HAYAKAWA AND S. TOMONAGA. *J. Sci. Res. Inst., Tokyo*, **43**, 7–18 (*Dec.*, 1948).

The difficulties in accounting for atmospheric showers on the basis of primary protons are discussed. The photon emission at meson production, resulting from the consequent charge accelerations, is calculated in detail. This mechanism is shown to result in sufficient energy transfer to the electromagnetic field to account for the counter experiments on wide showers. The application to mixed showers under Pb absorbers is discussed. E. P. GEORGE

537.591.15

4178. The density spectrum of the flux of penetrating particles in wide atmospheric showers of cosmic rays. G. T. ZATSEPIN, I. L. ROZENTAL (ROSENTHAL), S. A. SLAVATINSKIĬ, G. B. KHRISTIANSEN (CHRISTIANSEN) AND L. A. SHUVAEV. *Dokl. Akad. Nauk, SSSR*, **69** (*No.* 3) 341–3 (1949) *In Russian.*

The exponent, γ, of the density spectrum was found to be 1·47 ± 0·07, by variation of counter tray area. The relations between the energy- and density-spectra are discussed. E. P. GEORGE

537.591.15

4179. On the angular and lateral scattering of electrons in a shower. A. BORSELLINO. *Nuovo Cim.*, **6**, 543–51 (*Nov.*, 1949) *In Italian.*

The authors determine analytically the angular and lateral mean square deviation of the electrons of a cascade shower referred to its axis for energies > critical (approximation A of Rossi and Greisen). The results are in accord with previous calculations.

U. CAMERINI

537.591.15

4180. Extensive and penetrating atmospheric showers. R. MAZE, A. FRÉON, J. DAUDIN AND P. AUGER. *Rev. Mod. Phys.*, **21**, 14–20 (*Jan.*, 1949).

Counter experiments at sea-level and at 5 000 m lead to the conclusions: (1) that atmospheric showers may be either "narrow" (~ 50 cm extension) or "extensive," with different altitude variations; (2) that under thick shields (~ 20 cm Pb) the extensive showers become hard and the lateral extension of the shower is reduced, the penetrating particles then remaining producing many secondaries (i.e. more than possible by mesons); (3) that the "narrow" showers lead to a phenomenon in Pb with a range ~ 100–200 g.cm^{-2}.

J. G. WILSON

537.591.15

4181. Results and problems concerning the extensive air showers. G. COCCONI. *Rev. Mod. Phys.*, **21**, 26–30 (*Jan.*, 1949).

The basic features of the soft component, the penetrating charged component and the neutron component of extensive air showers are summarized, and reasons given for supposing the penetrating particles to pre-exist in the showers before the experimental absorbing layers are reached.

J. G. WILSON

537.591.15

4182. Zenith angle dependence of extensive air showers. H. L. KRAYBILL. Letter in *Phys. Rev.*, **77**, 410–11 (*Feb.* 1, 1950).

537.591.3

4183. On some low ionizing radiation observed by measurements of cosmic radiation at great depths. M. MIESOWICZ, L. JURKIEWICZ AND J. M. MASSALSKI. *Phys. Rev.*, **77**, 380–3 (*Feb.* 1, 1950).

By measurements of 2-, 3- and 4-fold coincidences with a counter telescope, the underground rays at 660 and 540 m water equivalent have been divided into two components. One of the components is ionizing, discharging the counters with almost 100% efficiency, and has a strong maximum in the vertical direction. The other component discharges the counters with a very low efficiency, producing numerous 2-fold coincidences but practically no 3- or 4-fold coincidences. It is isotropic in direction and rapidly absorbed in Pb. This second component is thought to be composed of γ-rays of local radioactive origin. The telescope used in these experiments differed from that of Barnóthy and Forró in that it was protected from side showers by anticoincidence counters. The ratio of 2- to 3-fold coincidences was found to be about 1·4 instead of 20 as reported by Barnóthy and Forró at 1 000 m w.e. [see Abstr. 1089 (1949)]. A.

537.591.3

4184. Anomalies of the absorption curve of cosmic rays in lead. E. FENYVES AND O. HAIMAN. Letter in *Nature, Lond.*, **165**, 244 (*Feb.* 11, 1950).

537.591.3 : 539.18

On the absence of photons among the decay products of the 2·2 microsecond meson. *See Abstr.* 4370

537.591.5 : 523.72

4185. Solar influences on cosmic rays. A. DUPERIER. "*Relations between solar and terrestrial phenomena*," *Sixth report, I.C.S.U.* (1948) 193–8.

Harmonic analysis of systematic observations of cosmic-ray intensity in England has revealed, after correction for pressure and temperature, diurnal (12 hr) and annual fluctuations, in addition to a sidereal variation. The amplitude of the diurnal wave is greater at the equinoxes (0·22%) than at the solstices (0·16%) with times of maxima at 3 and 15 hr. The seasonal wave has a maximum in June (0·77%) and minimum in December (0·06%), suggesting a close solar control. Since the ratio of amplitudes, June/December, approximates the ratio, $\cos^2$ (solar Z.D.) for these months, an effect of penetrating radiation coming directly from the sun is suggested. Additional evidence of a connection between solar activity and cosmic-ray intensity at sea-level has been obtained. During many magnetic storms a regular decrease in intensity amounting to as much as 11% is observed, though some storms of large range do not produce this effect. No satisfactory explanation has yet been found for this, or for the observed fact that the occurrence of a solar flare is accompanied by a simultaneous world-wide increase in cosmic-ray intensity. D. R. BARBER

537.591.8

4186. On the dependence of the meson intensity on atmospheric depth. A. WATAGHIN. *An. Acad. Brasil Ciênc.*, **21** (*No.* 4) 353–6 (1949).

The development of the meson component through depths in the atmosphere in which ionization can be neglected (to 300 g. cm^{-2}) is investigated for a power law primary spectrum, using the model for π-meson formation proposed by Wataghin. Satisfactory agreement with experiment is obtained for a nucleon collision length 150 g. cm^{-2} down to the point when ionization energy loss is no longer negligible.

J. G. WILSON

537.591.8

4187. Photographic evidence for the existence of a very heavy meson. L. LEPRINCE-RINGUET. *Rev. Mod. Phys.*, **21**, 42–3 (*Jan.*, 1949).

Reports a double star obtained in an emulsion at 4 300 m altitude. A particle near the end of its range gives rise to a star, one product of which is a π^- meson leading to a secondary star. The energy of products in the primary star lead to a lower limit of mass 700 m_0 for the particle producing it, which, for slow capture, must also be negative. J. G. WILSON

537.591.8

4188. A critique of ionisation measurements of nuclear disruptions produced by cosmic radiation. S. A. KORFF. *Rev. Mod. Phys.*, **21**, 75–81 (*Jan.*, 1949).

The highly ionizing processes which may be detected in proportional counters comprise cosmic-ray nuclear disintegrations, slow neutron capture processes, fast neutron recoils, protons, contamination α-particles and very dense cascades. The separation of these events by variation of shielding, counter size, pressure, nature of filling gas and other parameters is discussed. J. G. WILSON

537.591

4189. The energy spectrum of cosmic-radiati particles and photons. J. CLAY. *Rev. Mod. Phys* **21**, 82–93 (*Jan.*, 1949).

Experiments on the production of secondar electrons by mesons, the energy spectrum of th secondaries, and on the magnitude and spectrum the sea-level photon component are described. A account is also given of experiments concerning th existence of a second shower maximum under abou 150 g. cm^{-2} of heavy material. J. G. WILSO

537.591

4190. On the effect of lead above apparatus for th detection of low energy mesons. G. T. REYNOLD *Rev. Mod. Phys.*, **21**, 122–3 (*Jan.*, 1949).

An attempt to confirm the effect indicated by th sea-level spectrum—that the rate of slow meson should increase under a solid absorber up to abou 300 g. cm^{-2}—was rendered difficult by incomplet exclusion of electrons. It was concluded that n significant improvement accompanies the extensio of the absorbing layer beyond 9 in Pb. J. G. WILSO

537.591.

4191. On nuclear evaporations in the cosmic radia tion and the absorption of the nucleonic componen G. BERNARDINI, G. CORTINI AND A. MANFREDIN *Nuovo Cim.*, **6**, 456–70 (*Nov.*, 1949) *In Italian.*

The authors estimate the numbers of fast nucleon per proton primary produced in the atmosphere On the basis of this calculation the experimental result of other authors are interpreted and discussed.

U. CAMERIN

537.591.

4192. On the distribution in energy of particle ejected in nuclear evaporations. G. CORTINI. *Nuov Cim.*, **6**, 470–83 (*Nov.*, 1949) *In Italian.*

The energy distribution of the protons and α particles ejected in nuclear evaporations is determine by measurements of range. U. CAMERIN

537.591.

4193. On the positive excess of mesons at sea leve P. BASSI, E. CLEMENTEL, I. FILOSOFO AND G. PUPP *Nuovo Cim.*, **6**, 484–93 (*Nov.*, 1949) *In Italian.*

It is shown that up to energies of the order c 2×10^9 eV the positive excess does not decrease.

U. CAMERIN

537.591.

4194. On evaporation stars. E. CLEMENTEL AN G. PUPPI. *Nuovo Cim.*, **6**, 494–9 (*Nov.*, 1949) *I Italian.*

Applying Weiskopf evaporation theory to a drop model nucleus, the number of ionizing branches in nuclear evaporation is calculated as a function of th excitation energy. The results compare well with experimental results. U. CAMERIN

537.591.

4195. The spectrum of mesons under dense materials P. BUDINI AND G. POIANI. *Nuovo Cim.*, **7**, 13–2 (*Jan.*, 1950) *In Italian.*

This is calculated considering the ionization los as a function of energy, using Halpern and Hall' results [Abstr. 1870 (1948)].

537.591.8

4196. Nuclear disruptions in the stratosphere. M. SCHEIN AND J. J. LORD. *Nuovo Cim.*, **7**, 21–7 (*Jan.*, 1950).

Cosmic-ray stars obtained in the stratosphere by the use of free balloons are reported.

537.591.8

4197. Properties of particles emitted by nuclear explosions, and comparison of explosions in C and Pb. A. LOVATI, A. MURA, G. SALVINI AND G. TAGLIAFERRI. *Nuovo Cim.*, **7**, 36–47 (*Jan.*, 1950) *In Italian.*

Results obtained with a counter-controlled cloud-chamber at 3 500 m are given and mean free paths estimated for the penetrating particles. Comparison of results in C and Pb indicates that, at least for the latter, the incident nucleon interacts with > 1 nucleon of the same nucleus.

537.591.8

4198. Low energy mesons in the atmosphere. M. SANDS. *Phys. Rev.*, **77**, 180–93 (*Jan.* 15, 1950).

The dependence on altitude of the intensity of slow mesons, mesons with ranges less than 100 g. cm^{-2}, has been measured by the method of delayed coincidences for atmospheric depths down to 250 g. cm^{-2}. A.

537.591.8

4199. Mean free path of the particles produced in nuclear explosions and comparison between explosions in C and Pb. A. LOVATI, A. MURA, G. SALVINI AND G. TAGLIAFERRI. *Phys. Rev.*, **77**, 284–5 (*Jan.* 15, 1950).

537.591.8 : 539.166

4200. Production of gamma-rays in nuclear interactions of cosmic rays. B. P. GREGORY, B. ROSSI AND J. H. TINLOT. Letter in *Phys. Rev.*, **77**, 299–300 (*Jan.* 15, 1950).

In a cloud chamber containing both Al and Pb plates, 47 mixed showers have been observed. The electron cascades secondary to an initial nuclear interaction are usually initiated by a neutral particle. From the behaviour of these particles on passing through Al and Pb it is concluded they are photons. Their energies are consistent with the assumption that they arise from the decay of short-lived neutral mesons. E. P. GEORGE

537.591.8 : 539.172

The fluctuation problem of cascades. *See Abstr.* 4336.

537.591.8 : 539.172.3

4201. Some observations on the nuclear disintegrations caused by cosmic rays in photographic emulsions. N. PAGE. *Proc. Phys. Soc., Lond. A*, **63**, 250–8 (*March*, 1950).

An account is given of a study of 2 150 stars in Ilford *C*2 plates and 312 stars in Kodak *NT*4 plates exposed under different conditions. Possible values for the cross-section for star-producing collisions are discussed. It is concluded that this equals the geometrical cross-section of the nuclei, and that the stars producing particles are non-catastrophically absorbed, leading to the observed absorption cross-sections. It is shown that nuclear transparency could not account for the observed results. It is estimated that 17% of all stars and 40% of stars from which two or more lightly ionizing particles are emitted are caused by ionizing primary particles. The size distributions for stars caused by ionizing and non-ionizing particles are given, and possible explanations for the difference between them are considered. The experimental observations are in agreement with the theory that the star-producing particles are mainly neutrons and protons secondary to the primary cosmic rays. The variation with star size of the proportion of doubly charged to singly charged particles is found, and for stars of > 6 prongs is in agreement with Le Couteur's extension of the evaporation theory [Abstr. 4354 (1950)]. A value of 0·54 is deduced for the proportion of doubly charged particles from disintegrations in the light elements of the emulsion. An increase in the proportion of lightly ionizing tracks is observed for stars of > 8 prongs, and is ascribed to the creation of mesons. A.

MAGNETISM 538

538.082.102

4202. On the theory of the Sucksmith ring balance. E. SWINDLEHURST. *Proc. Leeds Phil. Lit. Soc.*, **5**, 224–35 (*Dec.*, 1949).

Exact expressions are derived for the vertical displacement of the lowest point of a Sucksmith ring balance and for the angular deflection of the tangent at any point, corresponding to a given deforming force. It is shown that for small deformations these expressions simplify and a direct method of obtaining the simplified expressions is outlined. The calculated sensitivity for small displacements is $<$ that obtained from the approximate relation given by Sucksmith [*Phil. Mag.*, **8**, 158 (1929)] by about $\frac{1}{4}$. A.

538.082.74 : 621.317.44

4203. On the fluxmeter. P. COURVOISIER. *Z. Naturforsch.*, **4a**, 496–8 (*Oct.*, 1949) *In German.*

Deviations from linearity in the relation between the exponential time constant of the after creep and the reciprocal resistance of the complete circuit show when the elementary theory (velocity damping control) of the fluxmeter cannot be used. T. S. E. THOMAS (R)

538.083.9

4204. A small milligaussmeter. G. D. ADAMS, R. W. DRESSEL AND F. E. TOWSLEY. *Rev. Sci. Instrum.*, **21**, 69–70 (*Jan.*, 1950).

Means are described for measuring magnetostatic fields from the order of 1 milligauss to 100 gauss. The operation consists of measuring the second harmonic content of the exciting current for a ferromagnetic strip which is normally excited to partial saturation. The second harmonic component appears when the strip is biased by an external magnetic field and the amount is directly $\propto$ this field over the bulk of the useful range. Methods of use are described. A.

538.1

4205. Some aspects of the theory of magnetism. J.-H. VAN VLECK. *Ann. Inst. Poincaré*, **10** (*No.* 2) 57–190 (1947) *In French.*

The text of 8 lectures given in 1939 and being a comprehensive theoretical account of dia-, para and ferromagnetism, treating the magnetic properties of

gases, rare earth salts and salts of the iron group. Adiabatic demagnetization, paramagnetic relaxation phenomena, theories of ferromagnetism and of ferromagnetic anisotropy are also considered.

A. E. DE BARR

538.114

4206. Limitations of the Bloch spin-wave treatment of ferromagnetism. E. P. WOHLFARTH. *Proc. Leeds Phil. Lit. Soc.*, **5**, 213–23 (*Dec.*, 1949).

A critical discussion.

538.221

4207. The temperature-relationship of the energetic constant of the magnetic anisotropy of nickel. L. V. KIRENSKIĬ. *Dokl. Akad. Nauk, SSSR*, **64** (*No.* 1) 53–6 (1949) *In Russian.*

The investigation in the interval from −183° to the Curie point was carried out by automatic measurement of the mechanical moments applied to a disc-shaped monocrystalline specimen placed in a strong homogeneous magnetic field. The author's and Bryukhatov's formula [*J. Exp. Theor. Phys.*, **6**, 198 (1938)] $K = K_0 \exp(-aT^2)$ was confirmed for lower temperatures, whereas it is not valid in the range of about 130°C where the constant changes its sign. Results also agree with those of Williams and Bozorth [*Phys. Rev.*, **56**, 837 (1939)]. B. F. KRAUS

538.221

4208. A demonstration of the induced magnetic moment in the third direction at gyromagnetic resonance. H. G. BELJERS. Letter in *Physica*, **16**, 75–6 (*Jan.*, 1950).

The preceding electron spins in ferromagnetic materials give rise to an alternating magnetic moment having a maximum value at resonance and which is perpendicular to the h.f. and static fields. The effect has been demonstrated using a ferrite sphere at a "magic tee" junction in a waveguide. G. F. HODSMAN

538.221

4209. Ferromagnetic resonance absorption by Mo permalloy at 2 920 Mc/sec. J. ITOH AND T. AKIOKA. Letter in *Phys. Rev.*, **77**, 293–4 (*Jan.* 15, 1950).

538.221

4210. Natural ferromagnetic resonance. A. J. E. WELCH, P. F. NICKS, A. FAIRWEATHER AND F. F. ROBERTS. Letter in *Phys. Rev.*, **77**, 403 (*Feb.* 1, 1950).

538.221

4211. [Influence of thermal fluctuations on] the magnetic after-effect of solid ferromagnetics in the Rayleigh region. L. NÉEL. *J. Phys. Radium*, **11**, 49–61 (*Feb.*, 1950) *In French.*

Discusses the effects of thermal fluctuations on domain boundary movement. General expressions are obtained for the hysteretic characteristics and the losses in a weak alternating field; the loss angle δ is shown to be independent of the field and of the frequency, and a relation is obtained between δ and the frequency dependence of the reversible susceptibility. The thermal fluctuations arise as a consequence of local changes of the effective field due to fluctuations of the direction of the spontaneous magnetization; the mean square fluctuation field, the time required for the disappearance of a given distribution of the magnetization vectors and the probability for the passage of a domain wall past an obstacle are calculated in terms of known parameters.

E. P. WOHLFARTH

538.222

4212. The principal magnetic susceptibilities of single crystals of rare earth salts at low temperatures. III. Neodymium salts. A. MOOKHERJI. *Indian J. Phys.*, **23**, 410–20 (*Sept.*, 1949).

These have been measured from room temperature down to liquid air temperature. The results are discussed in terms of crystalline field theory. It is found that (1) though the mean susceptibility can be explained satisfactorily on the basis of a single cubic field even of the fourth degree, the absolute magnitude of the fourth order cubic field estimated in this manner from the magnetic data will not be correct; (2) the cubic part of the field in the various salts estimated from magnetic data on the assumption that the cubic part of the field is wholly of the fourth degree, is found to vary markedly from crystal to crystal; (3) the influence of the fourth and sixth degree terms of the cubic field on the Stark splitting of the rare earth ions and in crystals, and their large magnetic anisotropy go to show that the low lying energy levels as observed in absorption spectra cannot be attributed to the cubic field alone; (4) the χ_1-axis of neodymium sulphate rotates by about 7° in the range studied. [See Abstr. 1080, 2570 (1950)]. A.

538.222

4213. The principal magnetic susceptibilities of single crystals of rare earth salts at low temperature. IV. Samarium salts. A. MOOKHERJI. *Indian J. Phys.*, **23**, 445–52 (*Nov.*, 1949).

These have been measured from 300°K to 85°K. The results are discussed in the light of crystal field theory. It has been found that the magnetic anisotropy of Ce, Pr and Nd salts increases as temperature is lowered, whereas in Sm salts it increases at first, then passing through a maximum decreases. A.

538.222

4214. New experiments on paramagnetic relaxation in iron ammonium alum and chromium potassium alum between 1 and 4°K. H. C. KRAMERS, D. BIJL AND C. J. GORTER. *Physica*, **16**, 65–74 (*Jan.*, 1950).

Paramagnetic relaxation at audiofrequencies has been studied in 3 samples of $FeNH_4$ alum and in 2 samples of CrK alum. In some of the samples there appears to be a continuous distribution of relaxation constants. From the dependence of the relaxation constants on the temperature and the constant magnetic field it may be concluded that first order absorption and emission processes are not yet predominant in the liquid He region. A.

538.222

4215. Magnetic susceptibilities of the halogen derivatives of methane. J. R. LACHER, R. E. SCRUBY AND J. C. PARK. *J. Amer. Chem. Soc.*, **72**, 333–6 (*Jan.*, 1950).

538.222

4216. The magnetic susceptibility of potassium ferrate. H. J. HROSTOWSKI AND A. B. SCOTT. *J. Chem. Phys.*, **18**, 105–9 (*Jan.*, 1950).

538.222

4217. The magnetic resonance spectrum of chrome alum observed by a dynamical method. R. MALVANO AND M. PANETTI. *Nuovo Cim.*, **7**, 28–35 (*Jan.* 20, 1950) *In Italian.*

538.222

4218. Variations of the paramagnetic Curie points of alloys with a palladium base. J. WUCHER. *C.R. Acad. Sci., Paris*, **230**, 730–2 (*Feb.* 20, 1950) *In French.*

538.222

4219. Spin-lattice relaxation in some paramagnetic salts. R. J. BENZIE AND A. H. COOKE. *Proc. Phys. Soc., Lond. A*, **63**, 201–12 (*March*, 1950).

The magnetization of a paramagnetic salt is a relaxation process with a relaxation time depending on the external field and temperature. Measurements have been made with the object of determining relaxation times at various fields and temperatures in the liquid He range. A description of the apparatus is given. The results show that paramagnetic relaxation is a complex phenomenon, and suggest that in any one specimen it must be described in terms of a distribution of relaxation times rather than a single relaxation time. In general it is found that relaxation times are of the order of 10^{-2} sec, with a temperature dependence according to a power of $1/T$ between 2 and 3, while increasing with the external field H according to a power of H between 0 and 1. A.

538.224

4220. The magnetic susceptibility of cyclo-octatetraene. II. The temperature coefficient of susceptibility from 195°K to 69°K. F. R. M. MCDONNELL, R. C. PINK AND A. R. UBBELOHDE. *Trans. Faraday Soc.*, **46**, 156–60 (*Feb.*, 1950).

538.224

4221. Magnetic susceptibilities of $TlCl_2$ and Tl_2Cl_3. D. J. MEIER AND C. S. GARNER. Letter in *J. Chem. Phys.*, **18**, 237 (*Feb.*, 1950).

538.244.2 : 537.534

Validity of two-dimensional design of synchrotron pole-faces. *See Abstr.* 4139

ELECTROMAGNETISM . ELECTRODYNAMICS 538.3/.5

538.3

4222. The electromagnetic field in a hemi-space. L. CAPRIOLI. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **7**, 103–6 (*July–Oct.*, 1949) *In Italian.*

An extension of the method of images is used to obtain expressions for the electric and magnetic field at a point P of a hemi-space, given the tangential component of E, E_t, on the plane which bounds the hemi-space. L. PINCHERLE

538.31

4223. Free energy and Lagrange function; application to electrodynamics and to the interaction between currents and permanent magnets. L. DE BROGLIE. *Portugal Phys.*, **3** (*No.* 1) 1–19 (1949) *In French.*

The analogy remarked by Helmholtz between the Lagrange function of a mechanical system and the thermodynamic idea of free energy is extended and is used to treat a variety of problems in electricity and magnetism, some of which have in the past been subjects of disagreement—such, for example, as Vaschy's theorem (concerning the mutual energy of currents and permanent magnets), which is important for understanding the dependence of ferromagnetism on electron spin. P. M. DAVIDSON

538.312 : 621.3.011.2

4224. On the impedance of free waves. E. BRYLINSKI. *Bull. Soc. Franç. Elect.* (*Sér.* 6) **10**, 37–40 (*Jan.*, 1950) *In French.*

$Z_0 = (\mu_0/\varepsilon_0)^{\frac{1}{2}}$ is associated with c as characterizing free space. Its dimensions vary with the systems of units employed. In the Giorgi system it appears as impedance, but it is preferable to call it the pseudo-impedance of free space or free waves and to measure it in pseudohms. Z_0 and c may also be regarded as vectors. The effect of rationalization is discussed. B. L. COLEMAN

538.566

4225. Approximate boundary conditions in diffraction problems. O. I. PANYCH. *Dokl. Akad. Nauk, SSSR*, **70** (*No.* 4) 589–92 (1950) *In Russian.*

538.566 : 535.42 : 621.396.11

4226. Diffraction by a cylindrical obstacle. C. H. PAPAS. *J. Appl. Phys.*, **21**, 318–25 (*April*, 1950).

The diffraction of a plane electromagnetic wave by an infinitely long, perfectly conducting cylinder has been treated by a variational method [see Abstr. 4694 (1949)]. The incident field is assumed to be polarized in the direction of the cylinder axis, and thus the entire field is of 2-dimensional nature. This formulation yields an expression for the diffracted cylindrical wave amplitude, at distances from the cylinder large compared to its transverse dimension and the wavelength, which is stationary relative to small independent variations of the surface currents arising from plane-wave excitation along a pair of directions in space; furthermore, the stationary form of the diffracted amplitude is independent of the scale of the surface currents. The total plane-wave scattering cross-section is simply related to the diffracted cylindrical wave amplitude in the direction of incidence. To examine the high frequency behaviour of the cross-section, the surface current induced by a plane wave is taken different from zero only on the illuminated part of the cylinder, where its value is derived from the tangential component of the incident magnetic field. The resulting cross-section is obtained and is shown to approach $4a$ when ka approaches ∞ ($k = 2\pi/\text{wavelength}$, a = radius of cylinder). A.

538.566.2 : 523.755

On the absorption of radio-waves in the solar corona. *See Abstr.* 3712

538.566.2 : 621.396.11

4227. On the internal reflection of electromagnetic waves in a stratified medium. Application to the troposphere. G. ECKART AND T. KAHAN. *C.R. Acad. Sci., Paris*, **228**, 1373–4 (*April* 25, 1949) *In French.*

The results of an analysis of the reflection coefficient of a stratified dielectric medium with an application to the case of reflection of radio waves by the troposphere are briefly presented. W. J. G. BEYNON

538.566.2 : 621.396.11

4228. On a problem of underwater radio-communication. L. CAPRIOLI. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **7,** 106–8 (*July–Oct.*, 1949) *In Italian.*

The formula established in a previous paper [see Abstr. 4222 (1950)] is applied to obtain an expression giving the upper limit of the electric field at any depth under the sea, when an upper limit can be estimated for its tangential component on the surface.

L. PINCHERLE

538.566.3

4229. On the relativistic electromagneto-ionic theory of wave propagation. V. A. BAILEY. Letter in *Phys. Rev.*, **77,** 418–19 (*Feb.* 1, 1950).

A brief indication is given of some recent developments of a relativistic theory of e.m. wave propagation in an ionized medium. [See also Abstr. 398 (1950)].

W. J. G. BEYNON

538.566.3 : 621.396.11

4230. Solar abnormal effects on the propagation of very long wireless waves. J. A. RATCLIFFE. "*Relations between solar and terrestrial phenomena,*" *Sixth report, I.C.S.U.* (1948) 87–9.

Within the wavelength region, 15 to 18 km reflection of the sky-wave occurs at ionospheric heights of 70 km by day, and 80 km by night. Records of the intensity, and phase of combined sky- and ground-waves at receiver give information of the state of ionization at these levels. Two distinct types of abnormal behaviour are noted: (1) a sudden phase anomaly (s.p.a.) indicating a lowered reflection height; and (2) a long-lived anomaly, exhibited as a marked departure from the normal mid-day values of phase and amplitude for time of year, which may last for 1–2 weeks. Type (1) anomaly has an average duration of 15 min and is allied to solar flare effects on short-wave transmissions, and to sudden increases of atmospherics.

D. R. BARBER

538.566.3 : 621.396.11

4231. Calculation of the absorption coefficient for the case of oblique incidence on a parabolic ionospheric layer. É. ARGENCE AND K. RAWER. *C.R. Acad. Sci., Paris,* **230,** 69–70 (*Jan.* 2, 1950) *In French.*

Further brief note on some mathematical expressions in Abstr. 2599 (1950).

W. J. G. BEYNON

538.566.3 : 621.396.11

4232. A probable explanation for certain ionospheric echoes of long delay. P. LEJAY AND J. DURAND. *C.R. Acad. Sci., Paris,* **230,** 493–5 (*Feb.* 6, 1950) *In French.*

It is suggested that, in normal incidence radio pulse sounding of the ionosphere, the diffuse echoes of range about 1 500 km often observed during the early morning hours of a winter day on frequencies mainly above the F_2 layer critical frequency, result from signals reflected obliquely from parts of the F_2 layer which have marked horizontal ionization gradients at such times.

W. J. G. BEYNON

MAGNETIC EFFECTS 538.6

538.632

4233. The Hall-effect of rubidium. E. KRAUTZ. *Z. Naturforsch.*, **5a,** 13–15 (*Jan.*, 1950) *In German.*

538.632

4234. The Hall effect of iridium. P. O. GEHLHOFF, E. JUSTI AND M. KOHLER. *Z. Naturforsch.*, **5a,** 16–18 (*Jan.*, 1950) *In German.*

538.653

4235. The approach to magnetic saturation in nickel under tension. O. BUHL. *Z. Phys.*, **126** (*No.* 1–2) 84–97 (1949) *In German.*

Develops a theory of the approach to saturation for (*a*) external tension parallel to *H*; (*b*) isotropically distributed internal stress. Measurements on two carbonyl-Ni wires under various tensions are consistent with the theory if local internal stresses due to plastic deformation, which may be several times the external tension, are postulated. This assumption is supported by the observation that with increasing tension the remanence at first falls rapidly but then maintains a practically constant value. Measurements after the removal of a large tension are also recorded, and from a comparison of the internal stresses calculated from the approach to saturation and from initial susceptibility, the existence of a "yield-point" is deduced at approximately the same stress as was found by a different method by Förster and Stambke [*Z. Metall.*, **33,** 97 (1941)].

C. E. WEBB

538.69 : 535.214

Magneto-photophoresis of omega iron in air. *See Abstr.* 3885

538.69 : 548.523

Action of a magnetic field on the crystallization of β-naphthol. *See Abstr.* 4476

THEORY OF SOLID STATE 539.11

539.11 : 536.7 : 666.11

What is glass? *See Abstr.* 4547

539.11 : 539.152.11

4236. Nuclear magnetic resonance line shape for a triangular configuration of nuclei. E. R. ANDREW AND R. BERSOHN. *J. Chem. Phys.*, **18,** 159–61 (*Feb.*, 1950).

The nuclear resonance line shape observed in solids can often be accounted for quantitatively and (in the absence of quadrupole effects) may provide information concerning the orientation and internuclear distances of dipolar nuclei. As an example of this method, the line shapes for a rigid and rotating triangular configuration of such nuclei are calculated and compared with recent experiments.

A.

MOLECULAR STRUCTURE 539.13

539.132

4237. Valence force displacement coordinates for systems in which the angles deviate from the ideal. P. TORKINGTON. *J. Chem. Phys.*, **18,** 93–7 (*Jan.*, 1950).

539.132

4238. Hexacovalent bond orbitals. II. G. H. DUFFEY. *J. Chem. Phys.*, **18,** 128–9 (*Jan.*, 1950).

Further calculations are reported on the set of

trigonal prism orbitals introduced in paper one of this series. The strongest orbitals found have a strength equal to 2·989. The results are used in discussing the difference in stability between these orbitals and the octahedral orbitals in structures of the following types: $Fe(CN)_6^{\equiv}$, $Fe(CN)_6^{\equiv}$ and SF_6. A.

539.132

4239. The energy of interaction between two hydrogen atoms. J. O. HIRSCHFELDER AND J. W. LINNETT. *J. Chem. Phys.*, **18**, 130–42 (*Jan.*, 1950).

The energy of interaction at intermediate to large separations is determined by the use of the variational principle applied to a wave function in which both ionic and polarization terms are included. The calculations extend from the smallest to the largest internuclear distances. For the normal H molecule a binding energy of 4·25 eV as compared to the experimental value of 4·74 eV is computed. Many new molecular integrals are evaluated and old ones are recalculated to greater accuracy. Convenient tables of these integrals together with all of the calculational details are given. A.

539.132

4240. The energy of the hydrogen molecule. E. F. GURNEE AND J. L. MAGEE. *J. Chem. Phys.*, **18**, 142–4 (*Jan.*, 1950).

A simple 2-parameter variational function has been used to calculate the energy of normal H. The first parameter is the usual scale factor; the second parameter is a distance of displacement of the atomic orbitals. The best potential energy is obtained as approximately 96 kcal per mole for internuclear separation $1{\cdot}45\,a_0$. The behaviour of the new parameter as a function of internuclear separation is discussed. A.

539.132

4241. Intramolecular forces between non-bonded atoms. D. F. HEATH AND J. W. LINNETT. Letter in *J. Chem. Phys.*, **18**, 147 (*Jan.*, 1950).

539.132

4242. Vector model for spin-orbit interaction in polyatomic molecules. S. I. WEISSMAN. Letter in *J. Chem. Phys.*, **18**, 232–3 (*Feb.*, 1950).

539.132

4243. Intensities of vibration bands. II. Bending vibrations of substituted benzenes and the dipole of the C–H link. A. R. H. COLE AND H. W. THOMPSON. *Trans. Faraday Soc.*, **46**, 103–9 (*Feb.*, 1950).

539.132

4244. Some molecular orbital calculations on the systems *o*- and *p*-$C_6H_4X_2$. V. GOLD. *Trans. Faraday Soc.*, **46**, 109–14 (*Feb.*, 1950).

539.132

4245. Molecular force fields. XII. Force constant relationships in the non-metallic hydrides. D. F. HEATH, J. W. LINNETT AND P. J. WHEATLEY. *Trans. Faraday Soc.*, **46**, 137–46 (*Feb.*, 1950).

539.132 : 539.27

4246. The structure of uranium hexafluoride as determined by the diffraction of electrons on the vapor. S. H. BAUER. *J. Chem. Phys.*, **18**, 27–41 (*Jan.*, 1950).

Special precautions were taken to eliminate sample contamination; both sector and non-sector photographs were analysed. The model which is in best agreement with the data is a distorted octahedron with 3 short (1·87 Å) and 3 long bonds (2·17 Å). However, a model with a centre of inversion, possessing 2 short (1·87 Å), 2 medium (2·12 Å) and 2 long bonds (2·22 Å) cannot be eliminated. The disagreement between the structures deduced from various technics is discussed, as are also possible experiments which might be done to resolve these differences. A.

539.132 : 539.27

4247. The structure of hexamethylcyclotrisiloxane as determined by the diffraction of electrons on the vapor. E. H. (WELLER) AGGARWAL AND S. H. BAUER. *J. Chem. Phys.*, **18**, 42–50 (*Jan.*, 1950).

539.133

4248. The electronic structure of conjugated systems. VI. B. H. CHIRGWIN AND C. A. COULSON. *Proc. Roy. Soc. A*, **201**, 196–209 (*March* 22, 1950).

539.133

4249. Extrapolation formulae in dipole moment measurements. R. J. W. LE FÈVRE. *Trans. Faraday Soc.*, **46**, 1–5 (*Jan.*, 1950).

539.133

4250. General valence-force displacement co-ordinates. P. TORKINGTON. *Trans. Faraday Soc.*, **46**, 27–34 (*Jan.*, 1950).

General valence-force displacement co-ordinates for non-tetrahedral substituted methanes are obtained. From the equations given, symmetry co-ordinates for practically any system can be readily derived. A.

539.133

4251. Dipole moments of resonance structures and the ultraviolet absorption maxima of anthracene. M. A. GOVINDA RAO AND K. VENKATARAMAN. *Curr. Sci.*, **19**, 9–10 (*Jan.*, 1950).

539.133

4252. The vibrational frequencies of ethylene. R. L. ARNETT AND B. L. CRAWFORD, JR. *J. Chem. Phys.*, **18**, 118–26 (*Jan.*, 1950).

539.133

4253. A theoretical calculation of the resonance energies and ultraviolet spectra of benzene and naphthalene. J. VAN DRANEN AND J. A. A. KETELAAR. Letter in *J. Chem. Phys.*, **18**, 151–2 (*Jan.*, 1950).

539.133

4254. Interatomic distances in CF_3Br, CF_3I, and CF_3CN. J. SHERIDAN AND W. GORDY. Letter in *Phys. Rev.*, **77**, 292–3 (*Jan.* 15, 1950).

539.133

4255. A contribution to the study of the Stark effect in the case of a rotator possessing a permanent dipole (case of the plane rotator). J. BARRIOL. *J. Phys. Radium*, **11**, 62–6 (*Feb.*, 1950) *In French.*

The exact solution of the Stark effect wave equation for the rotator in a plane is given and values of the parameters describing the lower energy levels are tabulated. These involve the values of λ for which the continued fraction $[\alpha - \lambda,\ 4\alpha - \lambda,\ 9\alpha - \lambda, \ldots p^2\alpha - \lambda, \ldots]$ is zero or infinite. D. H. WHIFFEN

539.133

4256. Stark–Zeeman effects on symmetric top molecules with nuclear quadrupole coupling. F. COESTER. *Phys. Rev.*, **77**, 454–62 (*Feb.* 15, 1950).

The effects of simultaneous electric and magnetic

fields are investigated. In weak parallel fields the Stark components are merely moved by the magnetic field if the Stark effect is linear, and split into two lines if the Stark effect is quadratic. In strong parallel fields the Stark components are split into 2 or 4 lines respectively. The intensities are not affected by the relative strength of the fields. In crossed fields a more complex pattern results. The intensities depend on the relative strength of electric and magnetic fields. A.

539.133

4257. Molecular dipole moments and Stark effects. II. Stark effects in OCS. R. G. SHULMAN AND C. H. TOWNES. *Phys. Rev.*, 77, 500–6 (*Feb.* 15, 1950).

The dipole moments of OCS for several isotopic species and vibrational states have been determined from the Stark splitting of the $J = 1 \rightarrow 2$ rotational transition. The value of the $O^{16}C^{12}S^{32}$ moment is $0{\cdot}7085 \pm 0{\cdot}004$ debye units. The $O^{16}C^{12}S^{34}$ and $O^{16}C^{13}S^{32}$ moments differ from this by less than $0{\cdot}2\%$. The $O^{16}C^{12}S^{32}$ molecule in the excited bending mode ($v_2 = 1$) is treated formally as a slightly asymmetric top which produces a doublet. Measurement of Stark effect for these lines gives a dipole moment of $0{\cdot}700 \pm 0{\cdot}004$ debye. Upon introduction of a Stark voltage, two weak lines appear on either side of the doublet $v_2 = 1$. They are explained as transitions involving the doublet levels which are forbidden in zero field, but allowed upon the introduction of a perturbing field. A.

539.133 : 537.226.2

Examination of the innermolecular mobility of dipole molecules in liquids by means of dielectric relaxation. *See Abstr.* 4061

ATOMIC STRUCTURE : ISOTOPES 539.15

539.152.1

4258. On the existence of an excited state of the deuteron. S. NAKAGAWA. *J. Sci. Res. Inst., Tokyo*, 43, 10–20 (*Sept.*, 1948).

The observation of 3 γ-rays of 2·2, 1·4 and 0·8 MeV, energy from the capture of neutrons by protons by Nakagawa, Sumoto and Arai [*Proc. Imp. Acad. Tokyo*, 19, 373 (1943)], is taken to be due to the existence of an excited state of the deuteron at either 1·4, or 0·8 MeV. Flugge's interaction potential [Abstr. 579 (1940)] is used in the calculations, since it takes the same form when operating on the ^1S and $^3S_1 + {}^3D_1$ wave functions as the Rarita and Schwinger theory [Abstr. 1076, 1356 (1941)], but has one more coefficient. A rectangular potential well was used as the radial interaction potential, and all calculations were made with two ranges of nuclear forces, 2·3 and $2{\cdot}8 \times 10^{-13}$ cm. Assuming the excited state to be a P state, it is found that only in the $^3P_1$ state is the potential attractive. The interaction constants are fixed using the known values of the magnetic moment, quadrupole moment, and ground state energy of the deuteron and cross-section for the radiative capture of slow neutrons by protons. The total and the differential cross-sections for n–p scattering at 2·82 and 15·3 MeV, and the total cross-section and the angular distribution for the disintegration of the deuteron by 2·62 and 17·5 MeV, γ-rays are calculated, and given in tables. A table is given comparing the parameters used by the author with those used by Rarita and Schwinger, and comparing the computed quantities from both theories with experimental values. J. HUGHES

539.152.1

4259. The problem of nuclear structure: the $N_{10}P_6$ nodal. O. MONECKE. *Experientia*, 6 (*No.* 2) 51–2 (1950) *In German.*

It is shown that the rule of Niggli and Sonder can be interpreted as a structure effect when the isotopes are divided into groups and families. On the basis of the family with $m = 4n$ it is demonstrated that the phenomena can be understood on the hypothesis that the nuclei of this family are composed only of $N_{10}P_6$- and N_2P_2-bodies. The latter incline to duplication, so that even numbers of N_2P_2-bodies, and especially the number 10, lend the nucleus increased stability, as can easily be proved statistically. A.

539.152.1

4260. Binding energies and the energy surfaces in the region of the natural radioactive isotopes. A. H. WAPSTRA. *Physica*, 16, 33–50 (*Jan.*, 1950).

As is well known the binding energies of the heavy natural radio-isotopes can be computed relative to the last member of each radioactive series. In this paper by a method of interpolation we determine all binding energies relative to Pb^{206}. It is found that the energy surfaces have some irregularities in common. The distances between these surfaces show a peculiar course incompatible with the well-known formula $\delta = cA^{-\frac{3}{2}}$. A.

539.152.1

4261. A new determination of some radii of heavy radioactive nuclei. S. ROSENBLUM AND M. VALADARES. *C.R. Acad. Sci., Paris*, 230, 384–6 (*Jan.* 23, 1950) *In French.*

The radii of nuclei are calculated knowing the disintegration constant, and the energies and relative intensities of the α-particle groups. It is found that they lie on a smooth curve as a function of A, the mass number, for the Ra series $A = 4n + 2$, and the Th series $A = 4n$, for those nuclei for which the α-particle fine structure is known. It is suggested that the curve could be used to indicate whether a particular nucleus had an α-particle fine structure, according as to whether its calculated radius, assuming no fine structure, lies on the curve or not. J. HUGHES

539.152.1

4262. Nuclear dipole vibrations and the surface symmetry energy. R. D. PRESENT. *Phys. Rev.*, 77, 355–6 (*Feb.* 1, 1950).

The frequency of nuclear electric dipole vibrations of the type suggested by Goldhaber and Teller [Abstr. 659 (1949)] is derived on the basis of the semi-empirical nuclear model. The resulting formula, taken together with the (γ, n) and (γ, f) cross-section data of Baldwin and Klaiber, determines a lower bound for the term in the surface energy depending on $N - Z$ (surface symmetry energy). This is close to an upper bound estimated by Feenberg, and one

may tentatively assume that the nuclear surface tension contains a factor $1 - 0{\cdot}4(N-Z)^2A^{-2}$. A.

539.152.1

4263. The hyperfine structure of the stable isotopes of indium. A. K. MANN AND P. KUSCH. *Phys. Rev.*, **77**, 427–35 (*Feb.* 15, 1950).

539.152.1

4264. The spherical shell nuclear model. H. A. WILSON. *Phys. Rev.*, **77**, 516–20 (*Feb.* 15, 1950).

The spherical shell nuclear model proposed in 1946 [Abstr. 2359 (1946)] is discussed and shown to be stable for uniform radial displacements. The level spacing at high excitations on the shell theory is $\geqslant$ than on current theories. It is shown that the experimental evidence on level spacing can be explained on the shell theory. A.

539.152.1 : 530.145.6

On the nuclear forces. *See Abstr.* 3784

539.152.1 : 537.534.74

4265. Proton-proton scattering and the triplet range of nuclear force. P. SWAN. Letter in *Phys. Rev.*, **77**, 288 (*Jan.* 15, 1950).

The phase shift for p-wave scattering of protons on protons at 10 MeV is computed as a function of the range of p–p triplet forces for a number of well-depths. From data on p–p scattering [Abstr. 1544 (1947)] an actual phase-shift of $(-0{\cdot}4 \pm 0{\cdot}1)°$ is inferred. Taking this value, a graph of possible well-depth *v.* possible range of forces is derived. An analogous curve for the n–p triplet interaction is obtained directly from a knowledge of the deuteron binding energy. The two curves intersect at a range of $(1{\cdot}65 \pm 0{\cdot}05) \times 10^{-13}$ cm, which is taken to be the common range of n–p and p–p forces in the triplet state. Agreement with experiments on scattering of slow neutrons by H_2 and NaH [Abstr. 1077, 2587 (1948)] is good. A. P. FRENCH

539.152.1 : 539.172

4266. Compound nucleus and nuclear resonances. V. F. WEISSKOPF. *Helv. Phys. Acta*, **23** (*No.* 1–2) 187–200 (1950).

A theoretical survey using the Bohr compound nucleus concept. The physical significance of the level spacing is discussed, and its relation to the motion of the nucleons within the nucleus. A relation between the particle width and the level spacing is simply derived and commented upon. The validity of the Bohr hypothesis is discussed in the non-resonance region, and the deviations to be expected if the compound nucleus is above the resonant region. Finally consideration is made of the limitations to be expected at incident particle energies > 50 MeV. J. HUGHES

539.152.2

4267. Upper limit of spin-spin interaction factor. G. J. BENE, P. M. DENIS AND C. R. EXTERMANN. Letter in *Phys. Rev.*, **77**, 288 (*Jan.* 15, 1950).

539.152.2

4268. Nuclear induction due to free Larmor precession. E. L. HAHN. Letter in *Phys. Rev.*, **77**, 297–8 (*Jan.* 15, 1950).

A nuclear induction signal is to be expected in the absence of an applied r.f. field, if the spin ensemble is perturbed by the application of a suitable r.f. field pulse of short duration. An experiment is reported which displays the effect using conventional r.f. techniques and typical nuclear induction apparatus. G. F. HODSMAN

539.153

4269. Electron screening and ionization potentials of neutral and singly ionized atoms. W. FINKELNBURG AND F. STERN. Letter in *Phys. Rev.*, **77**, 303 (*Jan.* 15, 1950).

539.153

4270. Ionization potentials of higher atomic ions. W. FINKELNBURG. Letter in *Phys. Rev.*, **77**, 304 (*Jan.* 15, 1950).

539.153

4271. On the resolution of the radial equation of hydrogen-like atoms. E. DURAND. *C.R. Acad. Sci., Paris*, **230**, 273–5 (*Jan.* 16, 1950) *In French.*

Formulae for a step-up process of obtaining the wave functions are established which are more convenient than Sommerfeld's polynomial forms. The operator of the radial equation is factorized by introducing two adjoint operators; the result $n \geqslant l + 1$ follows at once. J. JACOBS

539.153

4272. The structure of atoms from diffraction studies. H. HAUPTMAN AND J. KARLE. *Phys. Rev.*, **77**, 491–9 (*Feb.* 15, 1950).

A method is given for obtaining the electron distribution in atoms from diffraction data which makes use of the fact that the distribution function is positive. This property affords a basis for extrapolating the scattering data which are determined experimentally over only a finite range. This extrapolation is needed since the formula relating the electron distribution to the scattering function requires that the latter be known over an infinite range. A procedure for the extrapolation is given and the nature of the error is discussed. A.

539.154.2

4273. A symmetrical periodic system of chemical elements according to Pauli's principle. W. FINKE. *Z. Phys.*, **126** (*No.* 1–2) 106–7 (1949) *In German.*

A scheme for the arrangement of 120 elements is advanced. W. R. ANGUS

539.154.2

4274. The presentation of the periodic system in the form of a circle. F. SCHEELE. *Z. Naturforsch.*, **5a**, 11–13 (*Jan.*, 1950) *In German.*

539.155.2

4275. The isotopic constitution of erbium and lutecium. R. J. HAYDEN, D. C. HESS, JR. AND M. G. INGHRAM. Letter in *Phys. Rev.*, **77**, 299 (*Jan.* 15, 1950).

539.155.2

4276. Mass spectrographic identification of radioactive lanthanum isotopes. R. A. NAUMANN, F. L. REYNOLDS AND I. PERLMAN. Letter in *Phys. Rev.*, **77**, 398 (*Feb.* 1, 1950).

539.155.2

4277. The electromagnetic concentration of Be^{10}. C. P. KEIM, H. W. SAVAGE AND B. WEAVER. Letter in *Phys. Rev.*, **77**, 414 (*Feb.* 1, 1950).

539.155.2 : 533.15

4278. The separation tube. VIII. The enrichment of ^{13}C in methane. K. CLUSIUS AND G. DICKEL. *Helv. Phys. Acta*, **23** (*No.* 1–2) 103–7 (1950) *In German.*

Methane of molecular weight 16–211 was obtained, consisting of 82·1% $C^{12}H_4$, 17·0% $C^{13}H_4$ and 0·9% $C^{12}H_3D$. Because of the D content of normal methane, it is impossible to isolate pure $C^{13}H_4$ in one operation. Pre-enrichment of CO, and conversion with H to CH_4 and H_2O, would be better; the smaller mass difference between $C^{12}O^{16}$ and $C^{13}O^{16}$ would be compensated by the greater "hardness" of the CO molecule. A.

539.155.2 : 537.525

Oxygen isotope exchange in the electric discharge. *See Abstr.* 4107

RADIOACTIVITY . α-, β- AND γ-RAYS 539.16

539.16 : 614.8

Disposal of radioactive wastes by biological methods. *See Abstr.* 4573

539.16.08

4279. Age determinations by radiocarbon content: checks with samples of known age. J. R. ARNOLD AND W. F. LIBBY. *Science*, **110**, 678–80 (*Dec.* 23, 1949).

Measurements were made of the radioactivity of the C obtained from various archaeological samples of wood by combustion and reduction of the CO_2 with hot Mg. The specific activity plotted against historical age (up to 2650 B.C.) showed good agreement with the curve calculated from the known ½-life of radio-carbon. The authors discuss the possible applications of this technique to archaeology.

E. M. FOURNIER D'ALBE

539.16.08

4280. Units of radioactivity. L. F. CURTISS, R. D. EVANS, W. JOHNSON AND G. T. SEABORG. Letter in *Phys. Rev.*, **77**, 142 (*Jan.* 1, 1950).

Recommendation of the National Research Council (Nov., 1947) that the Curie be defined as the quantity of isotope giving $3{\cdot}700\times10^{10}$ disintegrations per sec and the Rutherford the quantity giving 10^6 per sec.

F. T. FARMER

539.16.08

4281. General relation between genuine and chance coincidences and its application to measurement of high activity sources. Z. BAY AND M. M. SLAWSKY. Letter in *Phys. Rev.*, **77**, 414–15 (*Feb.* 1, 1950).

539.16.08 : 537.542

An improved neon-lamp radium detector. *See Abstr.* 4155

539.16.08 : 537.542

Measurements of the energy of beta- and gamma-rays with a scintillation counter. *See Abstr.* 4162

539.16.08 : 537.542

Electrical apparatus giving automatically the distribution in time of nuclear events (particle emission). *See Abstr.* 4165

539.163

4282. The possible existence of a fourth natural radioactive series. J. H. J. POOLE, C. F. G. DELANEY AND R. C. MCCORMICK. *Sci. Proc. Roy. Dublin Soc.*, **25** (*No.* 9) 101–16 (1949).

The general position as regards the possible existence in nature of the Np or $4n + 1$ series is discussed. The existence in Ytterby mica of unexplained pleochroic halos, discovered by Joly in 1922, suggests that the Np series may be present. New measurements of the halos showed fairly definitely that these halos are not produced by the Np series. Further experiments on the nature of the radioactivity of Ytterby mica, using both the nuclear plate technique and an ionization chamber α-ray counter, are described. The general result of these is to prove that the $4n + 1$ series does not exist in the mica, at least in amounts comparable with those of the U and Th series. The paper concludes with a discussion of some peculiarities observed in the range distribution of the α-rays emitted by the mica. A.

539.163

4283. Working drawings of tools for handling radioactive sources. A. MORRISON AND K. J. PARRY. *Nat. Res. Coun. Can., Publ.* (*No.* 2025) 1 *p.* (1949).

539.163

4284. Shipping, storage and handling of cobalt 60. K. J. PARRY. *Nat. Res. Coun. Can., Publ.* (*No.* 2026) 9 *pp.* (1949).

539.163

4285. Radioactive and non-radioactive tracers; their production and uses. H. J. EMELÉUS. *Rev. Geofis.*, **8**, 262–73 (*April–Sept.*, 1949).

Short review article.

539.163

4286. Neutron deficient radioactive isotopes of rhenium. G. WILKINSON AND H. G. HICKS. *Phys. Rev.*, **77**, 314–18 (*Feb.* 1, 1950).

Using a 60 in cyclotron, bombardments have been made of Ta with 38, 30 and 19 MeV α-particles, of W with 10 MeV protons, and of Re with fast neutrons. The radiation characteristics of 4 new radioactive isotopes and of the previously known 50 d Re^{184} isotope have been studied. A.

539.163

4287. An investigation of the disintegration schemes of Ru^{103} and Rb^{86}. C. E. MANDEVILLE AND E. SHAPIRO. *Phys. Rev.*, **77**, 439–41 (*Feb.* 15, 1950).

The disintegration schemes of the 42 d Ru^{103} and the 19 d Rb^{86} have been studied with the use of absorption and coincidence methods. 92% of the disintegrations of Ru^{103} proceed by way of an inner β-ray group at 0·15 MeV coincident in time with a γ-ray of energy 0·52 MeV, which is (4 ± 1) % converted. A harder β-spectrum having a maximum energy of 0·68 MeV leads to the ground state of Rh^{103}. It is estimated that (12 ± 2) % of the β-rays of Rb^{86} are contained in the inner spectrum. A.

539.163 : 533.15

4288. An experimental determination of the distribution of the radon decay products in a gas-filled spherical vessel. C. R. MAXWELL, V. P. HENRI AND D. C. PETERSON. *J. Chem. Phys.*, **18**, 179–82 (*Feb.*, 1950).

The distributions of RaC and of (RaA + RaB)

between the walls and the gaseous phase of a spherical vessel filled with a gas-radon mixture were determined by the analyses of decay curves of the γ-activity of the radon decay products left on the walls of the vessel when it was rapidly evacuated. The distributions of RaA and RaB were determined from these data. The effects of the size of the flask, the pressure of the gas and the type of gas upon these distributions were investigated. It is suggested that the distributions of RaA and RaB when expressed as a function of the distribution of RaC are independent of these variables. The distributions in benzene and in CO_2 are reported. A.

539.163 : 541.142

Chemical effects accompanying the decay of Mn 51. *See Abstr.* 4433

539.163 : 578

Methods of biological research with the aid of radioactive isotopes. *See Abstr.* 4565

539.163 : 578

Account of the history of the biological application of indicators. *See Abstr.* 4566

539.163.1

4289. Can external factors modify radioactive decay constants? R. DAUDEL. *Rev. Geofis.*, **8**, 219–30 (*April–Sept.*, 1949) *In Spanish.*

It is conceivable that, particularly in the case of β-disintegrations by capture of a *K*- or *L*-electron, the decay constant should depend slightly on the degree of ionization of the atom. Thus the $\frac{1}{2}$-life of Be^7 in the form of $BeCl_2$ should $>$ that of metallic Be^7, because in the chloride the *L*-electrons of Be have attached themselves to Cl atoms. The present paper reports experimental results which seem to indicate that such an effect exists, though the observed difference is of the same order of magnitude as the experimental errors. L. PINCHERLE

539.163.1

4290. Measurement of the disintegration rate of sodium by the coincidence method. J. L. HERSON. *J. Res. Nat. Bur. Stand., Wash.*, **43**, 543–5 (*Dec.*, 1949).

Prevention of false coincidences and the separation of the total γ-counts observed in the basic measurements into nuclear and annihilation radiation incident to the positron emission is accomplished by magnetic deflection and a series of supplementary measurements in which a Pt-cylinder G–M γ-counter is used. A Cu cylinder γ-counter was used in the basic measurements. The disintegration rate of the test source was found to be $2{\cdot}15 \times 10^4$ disintegrations/sec with a conservatively estimated accuracy of $\pm 5\%$. Of the total γ-counts, 70% was of nuclear origin; whereas 30% were due to annihilation radiation. The efficiency of the Pt counter relative to that of the Cu counter in detecting annihilation radiation (0·51 MeV) was 2·9. Their detecting efficiencies for nuclear γ-radiation (1·3 MeV) were nearly alike. A.

539.163.1

4291. Short-lived fission products. II. Cs^{139} and Cs^{140}. N. SUGARMAN AND H. RICHTER. *J. Chem. Phys.*, **18**, 174–8 (*Feb.*, 1950).

Half-life values have been obtained for Cs^{139} and Cs^{140} by extraction of the Ba descendant activities from Cs silicotungstate precipitates. The $\frac{1}{2}$-life of Cs^{139} was found to be $9{\cdot}5 \pm 0{\cdot}2$ min by this technique and that of Cs^{140}, 66 ± 2 sec. The value for the Cs^{139} $\frac{1}{2}$-life was confirmed by observation of a Cs sample isolated directly from irradiated uranyl nitrate. [See Abstr. 3415 (1949)]. A.

539.163.1

4292. Calculation of decay times from coincidence experiments. Z. BAY. Letter in *Phys. Rev.*, **77**, 419 (*Feb.* 1, 1950).

539.163.1

4293. The half-life of Br^{82}. E. BERNE. Letter in *Phys. Rev.*, **77**, 568–9 (*Feb.* 15, 1950).

539.163.2

4294. The disintegration of In^{114}. J. Y. MEI, A. C. G. MITCHELL AND D. J. ZAFFARANO. Letter in *Phys. Rev.*, **76**, 1883–4 (*Dec.* 15, 1949).

Sources obtained by pile irradiation of metallic In were investigated in a lens spectrometer, using Pb and U radiators. *K*- and *L*-photoelectrons were observed, due to γ-rays of energies $0{\cdot}190 \pm 0{\cdot}004$, $0{\cdot}552 \pm 0{\cdot}005$ and $0{\cdot}722 \pm 0{\cdot}005$ keV and a weak radiation of $1{\cdot}27 \pm 0{\cdot}01$ keV, the relative intensities of these γ-rays being given as 257 : 47·9 : 47·7 : 3·2 respectively. The 0·190 keV radiation is emitted in the decay to the ground state of the 50 d isomer of In^{114}. It is suggested that the remaining γ-rays follow *K*-capture since the β-spectrum is simple and not accompanied by coincident γ-rays. A decay scheme is proposed. L. R. SHEPHERD

539.163.2

4295. Radioactive lanthanum 140. J. M. CORK, H. B. KELLER, W. C. RUTLEDGE AND A. E. STODDARD. Letter in *Phys. Rev.*, **76**, 1886 (*Dec.* 15, 1949).

A highly purified La^{140} sample obtained by pile irradiation of La^{139}, showed very pure decay over 8 octaves with $t_{\frac{1}{2}} = 41{\cdot}4$ hr. The activity was examined in a photographic spectrometer and 16 conversion lines were found with energies < 500 keV, which were attributed to 12 transitions. A decay scheme is proposed, which is consistent with 9 of these transitions. This assigns values of 68·2, 130·9, 241·8, 396·6 and 564·9 to energy levels in Ce^{140}. L. R. SHEPHERD

539.163.2

4296. Radioactive xenon 125 and xenon 127. D. L. ANDERSON AND M. L. POOL. Letter in *Phys. Rev.*, **77**, 142 (*Jan.* 1, 1950).

Te enriched to 79·4% in Te^{122} was bombarded with α-particles to produce a 20 ± 1 hr activity. A chemical separation established that the activity was associated with a gas and it was assigned to Xe^{125} obtained by an (α, n) reaction. The radiation was identified as *K* X-rays of I showing that Xe^{125} decays by *K*-capture. A weak γ-radiation of 0·6 MeV was also revealed by Cu absorption. A 32 ± 2 day activity, previously obtained by p bombardment of I and assigned to Xe^{127}, was produced by an (α, n) reaction as a result of α-particle bombardment of the enriched Te^{124}. L. R. SHEPHERD

539.163.2 : 541.14

4297. A calculation of the energy absorbed in a spherical volume containing a gas-radon mixture. C. R. MAXWELL AND V. P. HENRI. *J. Chem. Phys.*, **18**, 207–10 (*Feb.*, 1950).

A graphical method for the calculation of the energy

absorbed from the α-particles emitted by radon and its decay products is described. Factors, calculated by this method, are presented for use in calculating the energy absorbed in any spherical volume. These factors are compared with similar factors calculated with analytical expressions presented by other investigators. The orders of magnitude of the energy absorbed from recoil atoms, β-particles and γ-rays are given. A.

539.164

4298. Beta-spectrum of praeseodymium 143. L. Feldman, L. Lidofsky, P. Macklin and C. S. Wu. Letter in *Phys. Rev.*, **76**, 1888 (*Dec.* 15, 1949).

A 20 μg Pr^{143} source (PrCl) was examined in a solenoid magnetic spectrometer of 3% resolution. A Kurie plot of the β-spectrum gave a straight line from 170 keV up to the end point, 932 $\pm$ 2 keV indicating an allowed type of distribution. The $\frac{1}{2}$-life of the decay was found to be 13·7 $\pm$ 0·1 d and the *ft* value calculated indicates that the transition is 1st or 2nd forbidden. L. R. SHEPHERD

539.165

4299. Some new types of radioactivity. R. Daudel. *Rev. Geofis.*, **8**, 231–48 (*April–Sept.*, 1949) *In French.*

A simple form of the β-ray theory is applied to the calculation of the probability of processes such as: (*a*) The capture of the β-particle by the emitting atom when empty spaces exist in the electronic rings. This capture is found to be very likely for heavy atoms. (*b*) The disintegration with simultaneous excitation of a planetary electron (either to an excited state or to the continuum). For $_1H^3$ the probability of excitation is found to be 40%. (*c*) Double β-emission without emission of a neutrino, and similar phenomena. This process has been postulated to explain the natural radioactivity of Rb. The correct order of magnitude of the $\frac{1}{2}$-life is obtained only by assuming a purely Majorana type of nuclear forces.

L. PINCHERLE

539.165

4300. Beta-spectrum of Au^{198}. B. S. Dzhelepov, A. A. Bashilov, A. V. Zolotavin and N. M. Antoneva. *Dokl. Akad. Nauk, SSSR*, **64** (*No.* 6) 803–6 (1949) *In Russian.*

539.165

4301. Tables of β-decay. I. The τf products. B. S. Dzhelepov and A. V. Kudryavtseva. *J. Exp. Theor. Phys., USSR*, **19**, 761–83 (*Sept.*, 1949) *In Russian.*

A table is given, for 313 β-active nuclei, of the $\frac{1}{2}$-lives, the upper energy limits and the decay schemes, based on the most reliable experimental data in papers reaching Leningrad before Jan. 1, 1949. 320 literature references are given. The products τf in the table have been calculated from the Fermi formula for f (mostly in its modified form due to Nordheim and Jost) for, although this is strictly applicable only to allowed transitions, data needed for the more exact formulae are not available and in any case the resulting value of τf should not be seriously wrong. A critical review is given of the sources and orders of magnitude of errors in the table. The table also gives the percentage of each branch in the case of complex spectra and indicates an assignment to the allowed or one of the forbidden classes. This is done on the basis of the magnitude of τf, viz.:—allowed transitions: $\tau f < 2\times10^4$; first forbidden transitions: $2\times10^4 < \tau f < 4\times10^5$; second and third forbidden transitions: $4\times10^5 < \tau f < 10^8$; higher than third forbidden transitions: $\tau f > 10^8$.

J. C. E. JENNINGS

539.165

4302. On the τf products in the theory of β-decay. B. S. Dzhelepov. *J. Exp. Theor. Phys., USSR*, **19**, 784–95 (*Sept.*, 1949) *In Russian.*

From the table of $\log \tau f$ in the preceding Abstr. a graph is drawn of the numbers of nuclei with τf values within a range of 0·2 in $\log \tau f$, against $\log \tau f$ as abscissa. Similar graphs are shown for β^+ and β^- emitters separately and for nuclei in the separate ranges $0 < Z \leqslant 30$, $30 < Z \leqslant 70$, $70 < Z \leqslant 93$. These show the division into allowed, first, second and third, and higher than third forbidden classes. That only 7% of all transitions belong to the allowed class is explained by supposing that an allowed transition is one in which there is no nuclear rearrangement [see Abstr. 455 (1950)]. This criterion agrees with the deductions from the $\log \tau f$ diagram in 313 out of 319 cases. Konopinski [Abstr. 929 (1944)] and others have supposed that, within any class of transitions, τf should depend strongly on Z. The present analysis does not bear this out, but it does indicate that the proportion of nuclei belonging to any one class of transitions does depend on Z. The reasons are reviewed for the distribution of the τf values within each class. The most important are concluded to be the existence of *K*-capture (the proportion of which it is often difficult to determine), of complex decay schemes and of nuclear isomerism. That the division into classes of transition is clearest for the group $0 < Z \leqslant 30$ bears out this view, for it is in this group that these factors are least important.

J. C. E. JENNINGS

539.165

4303. Internal conversion coefficient and mass assignment of the 57 min Se isomer. I. Bergström and S. Thulin. Letter in *Phys. Rev.*, **76**, 1718 (*Dec.* 1, 1949).

Isotopes of D-bombarded Se were isolated in an electromagnetic separator. The 57 min activity was found to correspond to mass 81 and a sufficient quantity was separated for a β-spectrometer investigation. The spectrum consisted of a continuum of end point 1·38 $\pm$ 0·05 MeV and *K* and *L* conversion lines due to a 104 $\pm$ 2 keV transition ($Se^{*}\ 81 \rightarrow Se\ 81$). The latter appears to be almost entirely converted with $K/L \sim 3{\cdot}9$. L. R. SHEPHERD

539.165

4304. Radiations from Zn^{65}. K. C. Mann, D. Rankin and P. N. Daykin. Letter in *Phys. Rev.*, **76**, 1719–20 (*Dec.* 1, 1949).

A strong thick source of Zn metal was examined in a thin lens spectrometer of 3·5% resolution. Positrons and negatrons were separated by means of a spiral baffle. A Kurie plot of the β^+ spectrum showed it was simple, with an end point 0·325 $\pm$ 0·002 MeV. The negatron spectrum consisted of a strong conversion line due to a transition of energy 1·120 $\pm$ 0·005 MeV and spurious Compton electrons from

the thick source material. Secondary electrons from a 50 mg/cm² U radiator included Compton electrons and K and L photoelectrons due to a γ-radiation of $1{\cdot}11 \pm 0{\cdot}005$ MeV, electrons from the annihilation radiation and photoelectrons, which might be K electrons due to a $0{\cdot}17 \pm 0{\cdot}02$ MeV γ-ray or L electrons due to a $0{\cdot}08 \pm 0{\cdot}02$ MeV radiation. The authors claim to find also a very weak Compton group due to a $1{\cdot}38 \pm 0{\cdot}03$ MeV γ-ray. L. R. SHEPHERD

539.165

4305. The beta-spectra of Cu^{64}. L. M. LANGER, R. D. MOFFAT AND H. C. PRICE. Letter in *Phys. Rev.*, **76**, 1725–6 (*Dec.* 1, 1949).

Very thin sources were obtained by evaporation of metallic Cu in vacuum. These were examined in a shaped magnetic field spectrometer. Kurie plots showed no departure from the Fermi theory in the negatron spectrum above 50 keV (with both sources) and deviation from linearity in the positron Kurie plot was $\ll$ that reported by earlier experimenters. L. R. SHEPHERD

539.165

4306. The positron and negatron spectra of Cu^{64}. G. E. OWEN AND C. S. COOK. Letter in *Phys. Rev.*, **76**, 1726–7 (*Dec.* 1, 1949).

Cu^{64} was prepared by the $Zn^{64}(n, p)$ reaction, the Zn being placed immediately behind a Be cyclotron target bombarded by deuterons. A deposit of pure Cu^{64} of thickness 10^{-4} μg/cm² was obtained by first electroplating the Cu on W wire and then evaporating on to 0·00025 in Al foil. The source was examined in a 6 cm radius of curvature spectrometer. Kurie plots of the positron and negatron spectra showed no departure from linearity down to 50 keV. L. R. SHEPHERD

539.165

4307. Experimental beta-gamma-angular correlation. R. L. GARWIN. Letter in *Phys. Rev.*, **76**, 1876 (*Dec.* 15, 1949).

Coincidence rates were measured between a fixed β-counter and a moveable γ-counter subtending various angles of separation (from 45° to 180°) at the source. The γ-counter consisted of a 1 cm thick anthracene crystal subtending 0·13 steradian at the source, while the β-counter employed a 50 mg/cm² layer of anthracene and subtended an angle of 0·07 steradian. 10 stage photomultipliers were used and a modified Rossi mixer of 0·04 μsec resolving time. The sources were thin (0·01–0·1 mg/cm²) and the arrangement situated in an evacuated tank to avoid β-scattering. The coincidence rates (per γ-count) were fitted to a $1 + b\cos^2\theta$ function for each source tested. Na^{24}, Co^{60}, Ru^{103}, Ru^{105}, Cd^{115}, Ir^{192} and Au^{198} were examined and in no case was $|b| > 0{\cdot}025$, indicating that the γ-emission is isotropic in all cases. L. R. SHEPHERD

539.165

4308. The beta-spectrum of $_{61}Pm^{147}$. L. LIDOFSKY, P. MACKLIN AND C. S. WU. Letter in *Phys. Rev.*, **76**, 1888–9 (*Dec.* 15, 1949).

Thin sources of $Pm^{147}Cl_3$ (< 30 μg/cm²) were deposited on 10 μg/cm² collodion backing and examined in a solenoid type β-spectrometer. An allowed Kurie plot of the β-spectrum was linear from 35 keV to the end-point 227 ± 1 keV (the deviation below 35 keV could be attributed to source thickness and window absorption). The ft value for the decay ($t_{\frac{1}{2}} = 3{\cdot}7$ y) is $1{\cdot}2 \times 10^7$ indicating a 1st or 2nd forbidden transition. L. R. SHEPHERD

539.165

4309. Corrections for beta-particle self-absorption. A. H. W. ATEN, JR. *Nucleonics*, **6**, 68–74 (*Jan.*, 1950).

Precautions and techniques involved in the preparation of β-sources for specific activity measurements are discussed. An expression is derived for the ratio of measured to true activity of a thick source assuming exponential absorption of the β-particles. This is used as the basis for a graph which permits the true activity of a sample to be deduced from that measured, with the help of a single absorption measurement in Al foil. Typical results are given for sources of different thickness prepared from a sample of Ca^{45}. L. R. SHEPHERD

539.165

4310. The beta-decay of B^{12} and Li^8. W. F. HORNYAK AND T. LAURITSEN. *Phys. Rev.*, **77**, 160–4 (*Jan.* 15, 1950).

The electron spectra of B^{12} and Li^8 have been studied, using a magnetic lens spectrometer. The end point of the B^{12} distribution is $13{\cdot}43 \pm 0{\cdot}06$ MeV, while the Li^8 spectrum tails off gradually with a shape which is consistent with the known broadness of the excited state of Be^8 to which the decay occurs. Neither distribution corresponds to the shape indicated for simple "allowed" transitions, but it seems probable that more than one state of the residual nuclei may be involved in the decay schemes. The discrepancy between the observed end point of the B^{12} spectrum and the mass differences suggests the existence of an excited state at 0·9 MeV either in B^{12} or C^{12}. A.

539.165

4311. The disintegration of Ag^{110}. K. SIEGBAHN. *Phys. Rev.*, **77**, 233–8 (*Jan.* 15, 1950).

A spectrometer and coincidence technique was used. The radiation contains a great number of β- and γ-components and the disintegration scheme is complicated. 4 β-components and 10 γ-rays have been found and their energies and intensities measured. The 225 day activity is due to an isomeric level in Ag, separated 116 keV from the 24 sec ground level. The internal conversion coefficient of the γ-ray at 656 keV has been determined to be $2{\cdot}5 \times 10^{-3}$ by means of coincidence spectrometry. The disintegration scheme is discussed. A.

539.165

4312. Beta-spectrum of Be^{10}. P. R. BELL AND J. M. CASSIDY. Letter in *Phys. Rev.*, **77**, 301–2 (*Jan.* 15, 1950).

539.165

4313. The beta-rays of K^{40}. P. R. BELL, B. WEAVER AND J. M. CASSIDY. Letter in *Phys. Rev.*, **77**, 399–400 (*Feb.* 1, 1950).

539.165

4314. Composite of experimental measurements of the energy-distribution among beta-particles from tritium. E. P. COOPER AND F. T. ROGERS, JR. Letter in *Phys. Rev.*, **77**, 402–3 (*Feb.* 1, 1950).

539.165

4315. Beta-spectrum and decay scheme of $_{65}Tb^{160}$. S. B. Burson, K. W. Blair and D. Saxon. Letter in *Phys. Rev.*, **77**, 403–4 (*Feb.* 1, 1950).

539.165

4316. The beta-spectrum of He^6. V. Perez-Mendez and H. Brown. Letter in *Phys. Rev.*, **77**, 404–5 (*Feb.* 1, 1950).

539.165

4317. The correction of specific β-radioactivity for self-absorption. C. H. Collie, P. F. D. Shaw and H. J. Gale. *Proc. Phys. Soc., Lond. A*, **63**, 282–90 (*March* 1, 1950).

The self-absorption of β-rays in radioactive films between 5 and 100 mg/cm² superficial density has been investigated. The marked departures from the exponential absorption law are shown to be due to scattering of the β-rays in the film. The use of very thin films to avoid the correction for self-absorption is not recommended as a routine method. A.

539.165.2

4318. Conversion electrons of radium D. L. Cranberg. *Phys. Rev.*, **77**, 155–9 (*Jan.* 15, 1950).

The conversion electrons of RaD have been studied with thin sources on thin backings in a β-ray spectrograph using calibrated photographic emulsions. The number of conversion electrons due to the 47 keV γ-ray has been measured to be 74 ± 5 per hundred disintegrations. The $L : M : N$ ratio is $1 : 0{\cdot}26 : 0{\cdot}077$. This implies a complex decay scheme for RaD, since earlier results give $3{\cdot}5$ unconverted 47 keV γ-rays per hundred disintegrations. A.

539.166

4319. The *L* and gamma spectra emitted in the transformation RaD → RaE. L. Salgueiro and M. Valadares. *Portugal. Phys.*, **3** (*No.* 1) 20–8 (1949) *In French.*

Using a Bragg crystal spectrometer the intensities and wavelengths of the *L* series X-rays are measured in the region of wavelength > 918 X units. An explanation is given of some of the anomalies in the observed intensities on the basis of the hypothesis of Coster and Kronig [*Physica*, **2**, 13 (1935)]. 4 new X-rays are observed in the region 1 200–1 800 X units. J. Hughes

539.166

4320. The angular correlation of scattered annihilation radiation. C. S. Wu and I. Shaknov. Letter in *Phys. Rev.*, **77**, 136 (*Jan.* 1, 1950).

Theory predicts that the two quanta emitted in the annihilation of a positron-electron pair with zero angular momentum are polarized at right angles to one another. This should lead to an asymmetry in the correlation between the azimuths of the scattered directions when both photons undergo a single scattering, the effect being maximum for a scattering angle of 82°. A Cu^{64} source, contained in an Al capsule, was placed at the centre of a $\frac{3}{8}$ in channel in a 6 in Pb cube, both ends of the channel being covered by cylindrical Al scatterers, each designed to scatter 40% of the annihilation radiation, but with $< 15\%$ probability of multiple scattering at 90°. The scattered quanta at $\sim 82°$ were observed by means of anthracene crystals (with RCA 5819 photomultipliers), each subtending 43° at the centre of the scatterers. The azimuth angle between the planes of the channe and the two directions of scattering could be varied Coincidence rates were measured with azimuth separations of 0°, 90°, 180° and 270°. The ratio o the coincidence rates with the scattering plane perpendicular, to those with planes parallel wa found to be $2{\cdot}04 \pm 0{\cdot}08$ in good agreement with value of $2{\cdot}00$ calculated from the theory for th geometry used. L. R. Shepherd

539.166

4321. On the angular distribution of two-photon annihilation radiation. S. DeBenedetti, C. E. Cowan W. R. Konneker and H. Primakoff. *Phys. Rev.* **77**, 205–12 (*Jan.* 15, 1950).

An experimental determination, using anthracen scintillation counters in coincidence, has been mad of the departure from antiparallelism of the two photons in the pair annihilation process in an Al absorber. The observed mean angular departure $\simeq 1/137$ radians, arises from the motion of the centres of mass of the annihilating pairs; the mean momentum of these is found from the experimenta data to be $= 1{\cdot}2\,mc/137$, a value to be compare with a lower limit of $0{\cdot}8\,mc/137$ obtained from an included theoretical discussion in which the momen tum probability amplitudes of the annihilating electrons and positrons (in the absorbing metal) are estimated and appropriately combined. In these estimates it is shown that the positrons become thermalized by collisions with the vibrating lattice atoms in times considerably $<$ the annihilation time so that only their zero point motions, together with the zero point motions of the annihilating (valence) electrons, effectively contribute to the momenta of the centres of mass of the annihilating pairs. A.

539.166

4322. A delayed coincidence counting measurement of $Hg^{203, 205}$. D. Binder. Letter in *Phys. Rev.*, **77** 291 (*Jan.* 15, 1950).

539.166

4323. Gamma-rays of K^{40}. P. R. Bell and J. M. Cassidy. Letter in *Phys. Rev.*, **77**, 409–10 (*Feb.* 1 1950).

539.166

4324. Bremsstrahlung for heavy elements at extreme relativistic energies. L. Bess. *Phys. Rev.*, **77**, 550–6 (*Feb.* 15, 1950).

The correction to the Born approximation has been found for high energy bremsstrahlung neglecting screening. The calculation involves using approxi mate Coulomb solutions to the Dirac equation which give the right phase and wave amplitude at large distances from the nucleus. The correction is found to decrease with increasing energies, and is $< 10\%$ for 15 MeV electrons and a Pb target. Moreover, unlike the non-relativistic case, the correction is independent of the sign of charge of the projectile. A.

539.166 : 535.312 : 537.531

Gamma-ray reflection properties from 500 X units to nine X units of unstressed and of bent quartz plates for use in the two-meter curved-crystal focusing gamma-ray spectrometer. *See Abstr.* 4110

539.166 : 537.591.8

Production of gamma rays in nuclear interactions of cosmic rays. *See Abstr.* 4200

539.166 : 778.33

Radiography with cobalt-60. *See Abstr.* 4589

539.166.2

4325. Nuclear gamma-radiation of Cu^{61}. F. Boehm, J. P. Blaser, P. Marmier and P. Preiswerk. Letter in *Phys. Rev.*, **77**, 295–6 (*Jan.* 15, 1950).

539.166.74

4326. Multiple Compton scattering. II. W. R. Faust. *Phys. Rev.*, **77**, 227–32 (*Jan.* 15, 1950).

[See Abstr. 2693 (1949)]. An experimental and theoretical investigation has been made of the intensity and spectral distribution of γ-radiation due to point and plane sources immersed in a homogeneous medium. The intensity is calculated by considering the multiple scattering as taking place in a succession of steps and the spatial distribution of the radiation is deduced from the equilibrium between quanta in a given group and those added to and removed from this group by scattering. A.

539.166.8

4327. Internal conversion of γ-rays and X-rays from *K*-capture in heavier atomic nuclei. R. M. Steffen. *Diss. E.T.H. Zürich*, 58 *pp.* (1949) *In German.*

The radiation from $Au^{194, 195, 196, 198}$ obtained by (p, n) reactions from Pt have been investigated by spectrometric methods and coincidence techniques using calibrated counter arrangements. Complete decay schemes have been obtained; all of the 4 Au isotopes were found to decay by *K*-capture; which in the cases of Au^{196} and Au^{198} is accompanied by β^--emission. The internal conversion coefficients α_K and α_L of the various γ-rays have been carefully measured and the multipole character of the transitions deduced therefrom. By measuring the yields of Auger electrons accompanying the *K*-capture processes in Pt, the internal conversion coefficients for X-rays were determined and found in quantitative agreement with the relativistic theory developed by Massey and Burhop [*Proc. Roy. Soc. A*, **153**, 661 (1936)]. A.

539.166.8

4328. Ellis and Aston's theory of the height of a photoelectron line. H. O. W. Richardson. *Proc. Phys. Soc., Lond. A*, **63**, 234–40 (*March*, 1950).

The formula of Ellis and Aston relating the intensity of a γ-ray to the height of its photoelectron line produced from a thick target is revised using the quantum-mechanical theory of stopping power. The effects of multiple scattering, bremsstrahlung and anisotropic emission of the photoelectrons are discussed and a general comparison of thick and thin target methods is made. A.

539.166.8

4329. The "external" photoelectron spectrum and the intensities of the γ-rays of thorium (B + C + C′). D. G. E. Martin and H. O. W. Richardson. *Proc. Phys. Soc., Lond. A*, **63**, 223–33 (*March* 1, 1950).

The spectra of the photoelectrons ejected from various targets by the γ-rays of Th(B + C + C′) have been measured and the emission probabilities of the γ-rays of energy 0·238, 0·277, 0·299, 0·510, 0·582, 0·726 and 0·859 MeV have been estimated. Using the known intensities of the internal conversion lines, coefficients of internal conversion have been found. The 4 low-energy rays seem to be magnetic dipole in character with some electric quadripole admixture, but the strong 0·582 MeV ray of Pb^{208} is predominantly electric quadripole. The possible spins of the nuclear levels are discussed. A.

539.166.83

4330. The *K*-shell internal conversion coefficients. M. E. Rose, G. H. Goertzel, B. I. Spinrad, J. Harr and P. Strong. Letter in *Phys. Rev.*, **76**, 1883 (*Dec.* 15, 1949).

These have been calculated, using the Dirac relativistic wave functions for the Coulomb field, in the ranges $10 \leqslant z \leqslant 78$ with $0{\cdot}3 \leqslant k \leqslant 5{\cdot}0$ and $z > 78$ with $0{\cdot}5 \leqslant k \leqslant 5{\cdot}0$ (k = transition energy$/m_0c^2$), for electric and magnetic 2^l poles, $1 \leqslant l \leqslant 5$. The calculations were made on the Harvard University MkI calculator and the results will be published in detail together with corresponding results for conversion in the *L* sub-shells. A number of curves are given for electric dipole and 2^5 pole. Neglect of screening in these calculations is justified by comparison with the results of Reitz (for low energy *K*-conversion, allowing for screening), the differences between the two sets of results being always $< 10\%$ and in most cases $< 3\%$. A comparison with the approximate formulae of Hebb and Uhlenbeck, Drell and Dancoff and Morrison indicate that the latter have only a very restricted range of application and can lead to very serious errors.

L. R. SHEPHERD

NUCLEAR REACTIONS 539.17

539.17

4331. Detonation waves of nuclear explosions. P. Caldirola. Letter in *Nuovo Cim.*, **5**, 509–10 (*Oct.*, 1948) *In Italian.*

539.17

4332. On the statistical derivation of the laws of chemical equilibrium. O. Klein. *Nuovo Cim.* **6** (*Suppl. No.* 2) 171–80 (1949).

The laws are derived and used in the discussion of the equilibrium between atomic nuclei, nucleons, positive and negative electrons and neutrinos, on which the thermodynamical theory of the origin of the elements is based. In this discussion, the Gibbs' condition for the equilibrium of a fluid of equal particles in a gravitational field, arises. The corresponding condition in general relativity is discussed briefly. L. S. GODDARD

539.17

4333. Irreversible processes and the formation of nuclei. G. Wataghin. *Nuovo Cim.*, **6** (*Suppl. No.* 2) 241–3 (1949).

A contribution to the solution of the problem of the origin of nuclei. The theory of thermodynamical equilibrium conditions is applied to an assembly (of nucleons, electrons, mesons and nuclei) and radiation in a state of rapid expansion at temperatures $kT \sim 10^7$ eV and densities $\rho > 10^{12}$ g/cm^3. The results permit a calculation of relative abundances, which correspond roughly with observed values.

L. S. GODDARD

539.17

4334. Instrument needs of the radiochemical processing plant. V. L. PARSEGIAN. *Nucleonics*, **6**, 38–53 (*Jan.*, 1950).

The need for careful control of operations in chemical plant processing Pu, U, fission products, etc., introduces a number of new problems. These mostly arise out of the fact that instruments monitoring the process must operate in regions of intense radiation. Special attention has to be devoted to the problems of remote handling and replacement of defective instruments and effective methods of telemetering information from detectors to control panels in safe areas of low radiation intensity have to be devised. Detectors which have to measure such quantities as temperature, pressure, flow rate, liquid level, and radiation intensity, must satisfy a number of important requirements such as long life, stability, simplicity and easy replacement. Various detection methods for measuring these quantities and others are described. L. R. SHEPHERD

539.172

4335. Some general properties of nuclear reaction and scattering cross sections. T. TEICHMANN. *Phys. Rev.*, **77**, 506–15 (*Feb.* 15, 1950).

Deals with some general properties which can be derived from the dispersion-theoretic treatment given, for example, by Wigner and Eisenbud. The form of the cross-section near the resonances is found to satisfy the Breit–Wigner formula with corrections of the order Γ^2/D^2, Γ = level width, D = level spacing. In the region between the resonances, the behaviour is found to be of three types. In the first two types, simple minima occur differing in order of magnitude in the two cases by a factor Γ^2/D^2. In the third type, a flat non-resonance maximum occurs between the resonances considered, accompanied by two minima. This type of behaviour may be associated with a large fluctuation of Γ or D at some of the neighbouring levels. The cross-sections are explicitly calculated for some special choices of the Γ and D, and the averages compared with those of the statistical theory. The effect of the potential scattering on the scattering cross-sections is briefly discussed. A.

539.172 : 537.591.8

4336. Note on the fluctuation problem of cascades. L. JÁNOSSY. *Proc. Phys. Soc., Lond. A*, **63**, 241–9 (*March*, 1950).

Diffusion equations governing the fluctuations of nucleon cascades and also of electron–photon cascades are given. The electron cascade is treated at first in the usual approximation, but it is shown that the approximations are not essential for the treatment. The diffusion equations appear in the form of integro-differential equations which can be solved directly using numerical integration. A.

539.172.13

4337. On the α-activity of Bi bombarded with deuterons. A. SUGIMOTO. *Sci. Pap. Inst. Phys. Chem. Res., Tokyo* (*No.* 1183) 232–9 (*July*, 1947).

Deuterons of initial energy ~ 13 MeV fell upon an internal cyclotron target of Bi after being retarded to any desired extent by Cu foils. The energy scale was established by measuring the activity, following the $Cu^{63}(d,p)$ reaction, induced in the members of a stack of Cu retarding foils exposed to the beam, it being assumed that maximum activity was produced at 9 MeV D energy. The decay with time of α-activity in the target was followed over ~ 2 weeks; from the curve the relative initial amounts of RaE [from $Bi(d,p)$] and Po [from $Bi(d,n)$] could be found. The cross-section ratio $\sigma(d,p)/\sigma(d,n)$ was obtained in this way for a series of D energies from 5 MeV to 13 MeV; it was found to fall from 8 to 4 over this range. For these measurements a thick Bi target was used; to find absolute cross-sections, a thin target was bombarded at the highest D energy, and the beam current was measured from its heating effect. In units of 10^{-26} cm^2, $\sigma(d,p)$ is given as 4·1 and $\sigma(d,n)$ as 1·1 at 12·4 MeV. The variations of cross-section with energy are analysed; the Gamow penetration theory gives a moderately good fit for both, and an Oppenheimer–Phillips mechanism for the (d,p) reaction seems to be ruled out. A. P. FRENCH

539.172.13

4338. The (e,n) process in the deuteron. F. SCHLÖGL. *Z. Naturforsch.*, **4a**, 664–71 (*Dec.*, 1949) *In German.*

The cross-section and the neutron spectrum, for the reaction $^2D + e \rightarrow {}^1H + n + e$, is calculated as a function of the electron energy up to ~ 7 MeV. The interaction between the electron and the proton is treated by perturbation theory. The results are presented graphically. J. HUGHES

539.172.13

4339. Carrier-free radioisotopes from cyclotron targets. V. Preparation and isolation of Se^{75} from arsenic. W. M. GARRISON, R. D. MAXWELL AND J. G. HAMILTON. Letter in *J. Chem. Phys.*, **18**, 155 (*Jan.*, 1950).

539.172.13

4340. Cross section of the C^{12} $(p,\gamma)N^{13}$ reaction at low energies. C. L. BAILEY AND W. R. STRATTON. *Phys. Rev.*, **77**, 194–6 (*Jan.* 15, 1950).

The efficiency of the reaction has been measured over the energy range from 125 keV to 200 keV, with results which are in good agreement with those recently published by Hall and Fowler. The cross-section ranges from $1{\cdot}0\times10^{-33}$ cm^2 at 128 keV to 23×10^{-33} cm^2 at 194 keV. The thick-target yield of the reaction was measured, by detecting the N^{13} positron activity with an absolutely calibrated counter, and the cross-sections were obtained by differentiation of the thick-target yield curve. A.

539.172.13

4341. The cross section for the radiative capture of protons by C^{12} near 100 Kev. R. N. HALL AND W. A. FOWLER. *Phys. Rev.*, **77**, 197–204 (*Jan.* 15, 1950).

A low-voltage accelerator and high-current ion source has been used to determine the cross-section of the reaction $C^{12}(p,\gamma)N^{13}$ over the energy range from 88 to 128 keV. A counter arrangement is described which detects 26% of all the positrons from the decay of the N^{13} produced in the reaction and which has a low background rate of 5·5 counts/min. With this accelerator and detector, yields of the order of 10^{-16} positron per proton and cross-sections as low as 10^{-10} barn or 10^{-34} cm^2 can be measured with errors of the order of ± 20%. The cross-section for the $C^{12}(p,\gamma)N^{13}$ reaction has been found to fit the semi-

empirical expression $\sigma = 0{\cdot}0024E^{-1}\exp[-6E^{-\frac{1}{2}}]$ barn with E in MeV over the energy range measured. This is in satisfactory agreement with the Breit–Wigner one-level dispersion formula using constants determined at the 456 keV resonance. The astrophysical implications of these results in connection with the C–N cycle of nuclear reactions in stellar interiors are discussed. A.

539.172.13

4342. High energy photons from proton-nucleon collisions. R. Bjorklund, W. E. Crandall, B. J. Moyer and H. F. York. *Phys. Rev.*, **77**, 213–18 (*Jan.* 15, 1950).

High energy photons (up to 200 MeV) are emitted by various cyclotron targets when these are bombarded by protons with energies > 180 MeV. Spectral distributions, angular distributions, and yields are given for various proton energies and targets. Various possible origins are discussed in the light of the experimental observations. A.

539.172.13

4343. Erratum: Short range alpha-particles from fluorine and lithium bombarded by protons. W. E. Burcham and J. M. Freeman. Letter in *Phys. Rev.*, **77**, 287 (*Jan.* 15, 1950).

The excited state energy given in Abstr. 7262 (1949) should be $2{\cdot}9 \pm 0{\cdot}2$ MeV, not $2{\cdot}6 \pm 0{\cdot}2$ MeV.

539.172.13

4344. On the reaction $Mg^{24}(p,\gamma)Al^{25}$. T. Grotdal, O. M. Lönsjö, R. Tangen and I. Bergström. Letter in *Phys. Rev.*, **77**, 296–7 (*Jan.* 15, 1950).

Using separated Mg isotopes, resonances at 222 and 417 keV, observed in the bombardment of Mg with protons, are identified as belonging to this reaction, agreeing with the previous work of Tangen [*K. Norske Vidensk. Selsk. Skr.* (*No.* 1) (1946)]. J. HUGHES

539.172.13

4345. A note on the $Li^7(p,n)Be^7$ reaction and an excited state of Be^7. T. A. Hall. Letter in *Phys. Rev.*, **77**, 411–12 (*Feb.* 1, 1950).

539.172.13

4346. Neutrons from $Li^7(p,n)Be^7$. V. R. Johnson, M. J. W. Laubenstein and H. T. Richards. Letter in *Phys. Rev.*, **77**, 413–14 (*Feb.* 1, 1950).

539.172.13

4347. The production of fast deuterons in high energy nuclear reactions. G. F. Chew and M. L. Goldberger. *Phys. Rev.*, **77**, 470–5 (*Feb.* 15, 1950).

It is proposed that the fast deuterons observed among the products of high energy nuclear reactions are to be understood in terms of a "pick-up" or sudden rearrangement process. A theoretical treatment of such a process is given which suffices to interpret presently existing data. Further experiments are proposed to test the hypothesis critically, and a possible application of this type of experiment to the determination of nuclear wave functions is pointed out. A.

539.172.3

4348. Further investigations on proton isobars in the theory of radiation damping. Ning Hu. *Proc. Roy. Irish Acad.*, **52 A**, 223–52 (*Aug.*, 1949).

Heitler's theory of damping is used to calculate the cross-section for photo-disintegration of a proton isobar, and to obtain the magnetic moment in terms of the anomalous moments of the proton and neutron. H. McManus

539.172.3

4349. Photo-disintegration of rhodium. N. W. Curtis, J. Hornbostel, D. W. Lee and E. O. Salant. Letter in *Phys. Rev.*, **77**, 290–1 (*Jan.* 15, 1950).

539.172.3

4350. New radioactive isotopes produced by nuclear photo-disintegration. F. D. S. Butement. Letter in *Nature, Lond.*, **165**, 149 (*Jan.* 28, 1950).

Fourteen new activities, prepared by (γ,n) and (γ,p) reactions, using 23 MeV synchrotron X-rays, are reported. The decay times were studied with a thin-window Geiger counter and in many cases the radiating element was identified chemically. Irradiated elements included Se, Sm, Eu, Gd, Dy, Er, Yb, Hf, W, Os, Pt, Hg. L. R. Shepherd

539.172.3

4351. Observation of (γ,T), (γ,D) and (γ,np) reactions in boron. F. K. Goward, E. W. Titterton and J. J. Wilkins. Letter in *Proc. Phys. Soc., Lond. A*, **63**, 172–3 (*Feb.*, 1950).

Stars from the reactions: $B^{11} = H^3 + 2He^4 - 11{\cdot}1$ MeV, $B^{10} = H^2 + 2He^4 - 5{\cdot}8$ MeV, $B^{10} = n + p + 2He^4 - 8{\cdot}0$ MeV were observed in B-loaded photographic plates irradiated by a continuous spectrum of γ-rays, of peak energy 24 MeV, from a synchrotron. The events were identified by examining the momentum balance of the particles forming the star. A check on the identification was made by calculating the γ-ray energy from the energy release and assuming the threshold from the known mass values, the upper limit should be 24 MeV. J. HUGHES

539.172.3

4352. Experimental photo-fission thresholds in $_{92}U^{235}$, $_{92}U^{238}$, $_{92}U^{233}$, $_{94}Pu^{239}$, and $_{90}Th^{232}$. H. W. Koch, J. McElhinney and E. L. Gasteiger. *Phys. Rev.*, **77**, 329–36 (*Feb.* 1, 1950).

An investigation with a 20 MeV betatron is reported. A method of α-self-cancellation is described which permits the detection of fissions and the determination of threshold energies in the two highly α-active samples of $_{92}U^{233}$ and $_{94}Pu^{239}$. An investigation of the photo-neutron threshold in N and the energy calculation from mass data provided a check of the absolute energy scale obtained from voltage measurements on the betatron. A.

539.172.3

4353. The photo-disintegration of nitrogen at energies of 20 Mev to 100 Mev. E. R. Gaerttner and M. L. Yeater. Letter in *Phys. Rev.*, **77**, 570–1 (*Feb.* 15, 1950).

539.172.3

4354. The evaporation theory of nuclear disintegrations. K. J. Le Couteur. *Proc. Phys. Soc., Lond. A*, **63**, 259–82 (*March* 1, 1950).

The relationship between nuclear temperature and excitation energy is discussed taking into account the thermal expansion of the nucleus and the effect of the neutron excess. Using these results, the evaporation theory is put into a form suitable for the treatment of

highly excited nuclei. The competition between the emission of p, n, d, t and α-particle is considered in detail, using Weisskopf's method of detailed balance. Detailed numerical values are calculated for the disintegrations of AgBr observed in photographic plates. The main points of comparison with experiment are (i) the energy distribution of the evaporated particles, and (ii) the ratio of emission of singly and doubly charged particles. The comparison yields close information about the relationship of nuclear energy and temperature; the agreement with theory is as good as can be expected. It is necessary to assume that the Coulomb potential barrier is reduced at high excitation energies. A.

539.172.4

4355. Determination of the ratio of boron and uranium cross-sections by the photographic method. C. HAENNY, P. LERCH AND O. ROCHAT. *Helv. Phys. Acta*, **22** (*No.* 6) 609–11 (1949) *In French.*

Photographic plates impregnated with B and U were irradiated in paraffin by neutrons from a 50 mc Ra–Be source surrounded by 5 cm of Pb. Developing in solution slightly acidified with acetic acid improved the discrimination between the more densely ionized fission tracks and the much more numerous tracks of the U α-particles and also between the B α-particles and the γ-ray background. Cd screens were employed to distinguish fast U^{238} fissions from thermal U^{235} fissions. Assuming a $1/V$ law the ratio of the $B^{10}(n, \alpha)$ reaction cross-section to that for thermal fission in natural U is found to be 170 ± 34, whence at 2 200 m/sec the fission cross-section of U^{235} is found to be 580 ± 120 barn. L. R. SHEPHERD

539.172.4

4356. The chemistry of the transuranic elements. H. J. EMELÉUS. *Rev. Geofis.*, **8**, 249–61 (*April–Sept.*, 1949).

Short review article.

539.172.4

4357. Metallurgical and mining problems in atomic energy. J. D. COCKCROFT. *Atomics*, **1**, 45–51 (*Sept.*, 1949).

The objectives of the atomic energy programme are the production of nuclear explosives, the construction of research reactors and the development of power reactors. Metallurgical problems involved in reactor design include the production of highly purified U and Th metals, the nuclear fuel Pu, and metals such as Be and Zr, which are suitable for use in reactors, as sheathing for nuclear fuel elements (as alternatives to Al, used at present). The availability of ores of these metals is discussed and methods of extraction are outlined. L. R. SHEPHERD

539.172.4

4358. Engineering aspects of nuclear reactors. I. L. A. OHLINGER. *Nucleonics*, **5**, 38–49 (*Dec.*, 1949).

A general outline of the characteristics of nuclear reactors and some of the factors involved in their design. L. R. SHEPHERD

539.172.4

4359. Engineering aspects of nuclear reactors. II. L. A. OHLINGER. *Nucleonics*, **6**, 10–17, 25 (*Jan.*, 1950).

The reflector and radiation shield of a nuclear reactor are discussed. Methods of controlling reactors and removing the heat energy produced are outlined. L. R. SHEPHERD

539.172.4

4360. Nomograph for materials irradiation. J. M. CISAR. *Nucleonics*, **6**, 63–7 (*Jan.*, 1950).

A chart is reproduced, from which the specific activity in curies per mole of a radioisotope, produced by pile irradiation, can be quickly obtained given the $\frac{1}{2}$-life of the activity, the irradiation time, the thermal neutron activation cross-section and the thermal neutron flux at the position of irradiation. L. R. SHEPHERD

539.172.4 : 534.222.2

The atomic explosion of 1945. *See Abstr.* 3861

ATOM AND MOLECULE BEAMS MESONS . NEUTRONS 539.18

539.18

4361. Reflection of an atomic beam at the border of a magnetic field. H. FRIEDBURG AND W. PAUL. *Naturwissenshaften*, **37** (*No.* 1) 20 (1950) *In German.*

Shows experimentally that the behaviour of a beam of K atoms in an inhomogeneous magnetic field is analogous to optical refraction. J. THEWLIS

539.18

4362. Remarks on the energy distribution of disintegrated μ-mesons. S. HAYAKAWA AND J. NISHIMURA. Letter in *Progr. Theor. Phys.*, **4**, 577–8 (*Oct.–Dec.*, 1949).

A correct energy spectrum for μ-mesons has been used to improve some earlier calculations [Abstr. 1029 (1950)]. Experimental results on the number of μ-mesons produced suggests that nuclei lose at most one-half their energy to π-mesons. G. J. KYNCH

539.18

4363. Theory of meson production. W. HEITLER. *Rev. Mod. Phys.*, **21**, 113–21 (*Jan.*, 1949).

539.18

4364. Electron emitting power of stopped mesons. T. SIGURGEIRSSON AND K. A. YAMAKAWA. *Rev. Mod. Phys.*, **21**, 124–33 (*Jan.*, 1949).

The relative probabilities of capture and decay of negative μ-mesons arrested in an absorber as a function of Z has been studied (without magnetic separation of incident mesons) by determining the relative number of delayed electrons detected per meson stopped. The measurements indicate a value of Z_0 (equal probability of capture and decay) of the order 10 in agreement with the direct determinations. J. G. WILSON

539.18

4365. Selection rules for the dematerialization of a particle into two photons. C. N. YANG. *Phys. Rev.*, **77**, 242–5 (*Jan.* 15, 1950).

Selection rules are derived from the general principle of invariance under rotation and inversion. The polarization state of the photons is completely fixed by the selection rules for initial particles with spin < 2. These results which are independent of any specific assumption about the interactions may

possibly offer a method of deciding the symmetry nature of mesons which decay into 2 photons. A.

539.18

4366. Scattering of π-mesons by nucleons. M. JEAN AND J. PRENTKI. *C.R. Acad. Sci., Paris*, **230**, 365–7 (*Jan.* 23, 1950) *In French.*

The total cross-section for scattering is calculated, using Kemmer's symmetrical theory. P. M. DAVIDSON

539.18

4367. Fast protons from the absorption of π⁻-mesons by nuclei. S. TAMOR. Letter in *Phys. Rev.*, **77**, 412–13 (*Feb.* 1, 1950).

539.18

4368. The lifetime of the positive π-meson. E. A. MARTINELLI AND W. K. H. PANOFSKY. *Phys. Rev.*, **77**, 465–9 (*Feb.* 15, 1950).

This has been measured using a method similar to that used by Richardson for the negative π-meson [Abstr. 4991 (1949)]. The lifetime obtained is $\tau = 1{\cdot}97 \pm \times 10^{-8}$ sec or $\tau_{\frac{1}{2}} = 1{\cdot}37 \pm \times 10^{-8}$ sec. These values are about 2·5 probable errors from Richardson's value of $\tau = 7{\cdot}7 \pm \times 10^{-9}$ sec. The method has been extended so that two points on a decay curve could be determined and the geometry of the system determined to better accuracy. The geometry of the apparatus was checked by measuring the effective "lifetime" of the α-particles in the same configuration; this was found to be $> 0{\cdot}5 \times 10^{-6}$ sec. A.

539.18

4369. Moderation of negative mesons in hydrogen. I. Moderation from high energies to capture by an H_2 molecule. A. S. WIGHTMAN. *Phys. Rev.*, **77**, 521–8 (*Feb.* 15, 1950).

The moderation of negative μ- and π-mesons, as well as of hypothetical negative particles of mass 1 000 m and 1 837 m is described for a H moderator and a meson energy range: 10 MeV → 0 eV (capture by an H_2 molecule). In this energy range, there are three principal modes of energy loss by the mesons: (1) high energy ionization loss, describable by the ordinary stopping power theory; (2) energy loss due to nuclear collisions; (3) low energy ionization loss caused by non-adiabatic processes special to hydrogen. From estimates of the probability of these three processes, the moderation times of a meson in liquid H from 10 MeV to capture by an H_2 molecule are calculated. A.

539.18 : 530.145

The effective cross-section in nucleon-nucleon scattering in the super-many-time theory. *See Abstr.* 3778

539.18 : 530.145

On a pseudo-scalar theory of nuclear forces. *See Abstr.* 3779

539.18 : 537.591.8

4370. On the absence of photons among the decay products of the 2.2 microsecond meson. E. P. HINCKS AND B. PONTECORVO. *Canad. J. Res. A*, **28**, 29–43 (*Jan.*, 1950).

An experiment is described which tests the hypothesis that the cosmic ray meson with a mean life of 2·2 μsec decays into an electron and a photon. Geiger counter trays are used to select mesons incident on a graphite block, and to detect decay products emerging from the graphite. The electronic circuits record delayed coincidences that correspond to a decay event occurring between 0·6 and 5·3 μsec after a meson is stopped. The absence of delayed coincidences of a type that could be attributed to the simultaneous emission of an electron and a photon, each of ~ 50 MeV, shows that the above hypothesis of the meson decay process is incorrect. The experiment also demonstrates the absence of a hypothetical unstable neutral meson among the decay products. A.

539.18 : 778.3

Measurement of the mass of charged particles by grain counts in sensitive emulsions. *See Abstr.* 3664

539.185

4371. The signs of the magnetic moments of neutron and proton. H. H. STAUB AND E. H. ROGERS. *Helv. Phys. Acta*, **23** (*No.* 1–2) 63–92 (1950).

The fundamental importance is discussed, and earlier evidence given. For the neutron the molecular beam resonance method was used with rotating fields in an experimental arrangement similar to Bloch, Nicodemus, and Staub [Abstr. 701 (1949)]. The sign of the proton magnetic moment was determined by a nuclear induction experiment with water in the same rotating magnetic field. A detailed account of the experimental procedure and the analysis of the results is given. It was found that the sign of the proton magnetic moment is positive, and that of the neutron negative, in agreement with previous determinations. J. HUGHES

539.185

4372. Preparation and characteristics of a polonium–beryllium neutron source. J. W. T. SPINKS AND G. A. R. GRAHAM. *Canad. J. Res. A*, **28**, 60–6 (*Jan.*, 1950).

The preparation of a Po–Be sandwich containing 2·1 c of Po is described. The source emits 2×10^6 neutrons/sec and its γ-radiation is approximately equivalent to that of 0·2 mgm Ra in equilibrium with its decay products. Polar diagrams for the angular distribution of the fast neutrons are given. Emission data for two similar neutron sources, containing 3·2 and 3·5 c Po respectively, are given. A.

539.185

4373. Applications of total reflection of neutrons. M. HAMERMESH. Letter in *Phys. Rev.*, **77**, 140 (*Jan.* 1, 1950).

Briefly refers to the use of total reflection in the measurement of so-called "coherent" scattering cross-sections. The applications suggested are to (*a*) materials of low cross-section, e.g. V, where the sign of the scattering amplitude is in doubt, (*b*) highly absorbing materials, (*c*) H, and (*d*) neutron-electron interaction. J. THEWLIS

539.185

4374. The inelastic scattering of neutrons by light nuclei. L. E. BEGHIAN, M. A. GRACE, G. PRESTON AND H. HALBAN. Letter in *Phys. Rev.*, **77**, 286–7 (*Jan.* 15, 1950).

539.185

4375. Coherent neutron-proton scattering by liquid mirror reflection. D. J. HUGHES, M. T. BURGY AND G. R. RINGO. Letter in *Phys. Rev.*, **77**, 291–2 (*Jan.* 15, 1950).

A well-collimated beam of thermal neutrons is

reflected from the surface of tri-ethyl benzene, and, from a determination of the critical angle, the coherent scattering amplitude of the liquid is obtained and hence that of the proton (assuming that of C to be known). The critical wavelength for any one angle is obtained with the help of a calibrated Be mirror, and the use of tri-ethyl benzene or a similar liquid permits a degree of uncertainty in the measurement of critical angle. The value for a_H is $-3{\cdot}75 \pm 0{\cdot}03 \times 10^{-13}$ cm which is 5% lower than previous values. This implies that the triplet *n-p* range should be raised to $1{\cdot}71 \times 10^{-13}$ cm and that the singlet range will be increased by about 1×10^{-13} cm. J. THEWLIS

539.185

4376. Thermal neutron distribution in a slab of paraffin. B. S. SMITH AND J. H. TAIT. Letter in *Nature, Lond.*, **165**, 196 (*Feb.* 4, 1950).

This was measured using Mn detectors, and a pile as neutron source. The results are presented graphically, and compared with the theoretical curve, and previous measurements by Capron [Abstr. 5002 (1949)]. The reasons for disagreement with Capron's measurements are given. Tolerance flux is $\sim 1\,250/\text{cm}^2/\text{sec}$, for thermal neutrons entering normally to the body. J. HUGHES

539.185

4377. The neutron-proton interaction. R. S. CHRISTIAN AND E. W. HART. *Phys. Rev.*, **77**, 441–53 (*Feb.* 15, 1950).

An analysis of the high energy (40 and 90 MeV) experimental neutron-proton scattering results is presented. It is shown that there is good agreement with the theoretical predictions based on a potential model having a $\frac{1}{2}(1 + P_x)$ exchange dependence and a "long-tailed" radial dependence. There is evidence, furthermore, from the scattering for the inclusion of a tensor force. A comparison of the predictions of square well, exponential, and Yukawa radial dependences is included to illustrate the effect of different shape characteristics. A.

539.185 : 532.74

4378. Neutron diffraction in liquid sulfur, lead, and bismuth. O. CHAMBERLAIN. *Phys. Rev.*, **77**, 305–13 (*Feb.* 1, 1950).

A new type of diffraction instrument has been developed to minimize the disadvantage of the broad energy spectrum of available slow neutron sources. It has been used to study the diffraction patterns of the elements S, Pb and Bi in the liquid state. The patterns have been interpreted in terms of the distribution in separation distance of neighbouring pairs of atoms. The results are in reasonable agreement with X-ray diffraction of others. In liquid S each atom has two nearest neighbours at 2·1 Å. In liquid Pb there are 12 nearest neighbours at 3·4 Å. In liquid Bi an atom has on the average 8 neighbours within 4 Å, but the nearest neighbours are not well separated from those at greater distance. A.

539.185 : 536.48

4379. On the theory of slow neutron scattering by liquid helium. L. GOLDSTEIN, D. SWEENEY AND M. GOLDSTEIN. *Phys. Rev.*, 77, 319–29 (*Feb.* 1, 1950).

Using the extreme Bose–Einstein and Fermi–Dirac models of liquid He^3 and He^4, respectively, the theory of inelastic or incoherent slow neutron scattering by these liquids has been studied. In liquid He^4, for neutrons of kinetic energy considerably $> kT$, the incoherent differential cross-section per atom is always $\geqslant$ the free atom cross-section exhibited by these atoms in the classical limit of vanishing degeneracy. At constant liquid temperatures, $>$ the λ-point temperature, i.e. in the He^4 I region, the scattering has a maximum finite limit at vanishing scattering angles. This limit depends, at these small angles, on the liquid temperature only. The liquid cross-section decreases with increasing scattering angle and tends asymptotically toward its free atom value. The latter is approached faster the larger the kinetic energy of the incident neutrons. At liquid temperatures near the λ-point temperature, the vanishing small angle scattering cross-section becomes very large and becomes some $N^{\frac{1}{3}}$ times the free atom value at the λ-point. In the liquid He^4 II region the very small angle scattering cross-section increases as Θ^{-2}, Θ denoting the scattering angle. At constant scattering angles the scattering cross-section varies as a function of the liquid temperature. In the limit of high temperatures, or small degeneracy, it tends toward its asymptotic free atom value. As the liquid temperature decreases, or the degeneracy increases, the cross-section increases. At absolute zero the cross-section is also classical. The constant angle cross-section curves thus exhibit a maximum as a function of the temperature. In liquid He^3, the differential cross-section is always smaller, at small scattering angles, than the free atom cross-section. The latter is reached asymptotically at large scattering angles from below, in contrast with the symmetric fluid. At sufficiently large scattering angles, the constant angle cross-sections vary with temperature by exhibiting a minimum between the temperature of absolute zero and the limit of high temperatures or vanishing degeneracy. The fluid cross-section remains always finite and has no anomalies. These results correspond to collision processes in which the incident neutron loses momentum and energy. Since, however, in all practical cases, even the total loss of neutron kinetic energy to the target liquid He^4, over reasonable radiation times, cannot perturb the thermal equilibrium of the liquid, the inverse scattering processes have also been studied by using the principle of detailed balance. The resulting, direct plus inverse, liquid cross-sections have also been evaluated both in He^4 and He^3. In the latter, however the thermal equilibrium is far from being as well preserved as in liquid He^4, because of the large thermal neutron reaction cross-section, $n(He^3, p)H^3$. A.

539.185 : 537.542

4380. A high-efficiency neutron detector. J. C. DUCKWORTH, A. W. MERRISON AND A. WHITTAKER. Letter in *Nature, Lond.*, **165**, 69 (*Jan.* 14, 1950).

This is based on the efficient detection of the *n*-capture γ-rays in an anthracene scintillation counter. B, Cd, In and Sm detectors have been examined with mono-kinetic neutrons in the 0·04 to 0·2 eV, all samples (except In) being "black" over this range. Constant efficiencies were obtained over the energy range, $\sim 1\%$ for B and $\sim 4\%$ for the other detectors. The higher efficiency of Cd, In and Sm probably arises

out of the fact that several γ-rays are emitted per neutron captured while in B a single 480 keV γ-ray is emitted in 93% of the captures. It is suggested that detectors of this type can be made more efficient than BF_3 counters for neutrons in the range 100 eV to 100 keV. L. R. SHEPHERD

539.185 : 545.8

Neutron spectroscopy for chemical analysis. *See Abstr.* 4461

539.185 : 614.8

Maximum permissible exposure to thermal neutrons. *See Abstr.* 4574

STRUCTURE OF SOLIDS 539.2

539.21

4381. Solubility relations in ternary solid solutions of ionic compounds. C. WAGNER. *J. Chem. Phys.*, **18,** 62–8 (*Jan.*, 1950).

The variation of the solubility of a solute due to the presence of a second solute in a solid ionic compound as solvent is investigated theoretically. A.

539.211

4382. Method of measuring surface polish. A. MIRAU. *Rev. Opt.* (*Théor. Instrum.*) **29,** 25–6 (*Jan.*, 1950) *In French.*

Light from a point source is reflected or refracted at the test surface and brought to an approximate focus; beyond the focus is a photocell. The diffused light and total light are measured respectively with and without a small stop covering the geometrical image. The ratio indicates the degree of polish. The method is convenient for small or inaccessible surfaces; in the case of reflection from the inside of a cylinder it has been found sensitive when the pits have a depth up to 3 μ. G. F. LOTHIAN

539.215.6

4383. Effect of change of scale on sintering phenomena. C. HERRING. *J. Appl. Phys.*, **21,** 301–3 (*April*, 1950).

It is shown that when certain plausible assumptions are fulfilled simple scaling laws govern the times required to produce, by sintering at a given temperature, geometrically similar changes in two or more systems of solid particles which are identical geometrically except for a difference of scale. It is suggested that experimental studies of the effect of such a change of scale may prove valuable in identifying the predominant mechanism responsible for sintering under any particular set of conditions, and may also help to decide certain fundamental questions in fields such as creep and crystal growth. A.

539.262

4384. An X-ray scanning camera. J. THEWLIS AND A. R. POLLOCK. *J. Sci. Instrum.*, **27,** 72–3 (*March*, 1950).

A camera is described which is designed to eliminate spottiness from X-ray photographs of coarse-grained material, for work on crystalline orientation. It may also be used for averaging the orientation over a selected area of a fine-grained specimen or for determining average compositions. It is suitable for back-reflection, transmission or glancing-angle photographs, and the angle of incidence can be varied from 0 to 90°. Provision is made for increasing the completeness of the scan if the specimen grains are so coarse that the X-ray lines are not sufficiently smoothed out when the scanner is used in the normal way. A.

539.264

4385. Apparatus and methods employed in the X-ray examination of cement compounds at Birkbeck College Research Laboratories. J. W. JEFFERY. *Mag. Concr. Res.* (*No.* 2) 99–106 (*June*, 1949).

539.27

4386. On a method for the investigation of discontinuous thin layers in the electron microscope and for the preparation of replica films and sub-strates by means of the evaporation of silicon monoxide. G. HASS AND H. KEHLER. *Optik*, **5,** 48–52 (*April*, 1949) *In German.*

Describes the use of SiO films for replicas in electron microscopy and as sub-strates for electron diffraction. The films are prepared by the evaporation of Si and quartz at the same time. SiO is not affected by the usual solvents, is heat resisting and has desirable mechanical properties. The examination of Ag layers is discussed. J. THEWLIS

539.27

4387. The identification of surface films by means of electron diffraction. H. RAETHER. *Z. Naturforsch.*, **4a,** 582–7 (*Nov.*, 1949) *In German.*

A discussion of the influence of surface roughness on the electron diffraction patterns obtained from surfaces covered by thin films. 3 cases are considered, viz.: electron-optically flat (cleavage) surfaces, gently undulating (electrolytically polished) surfaces and rough (abraded or etched) surfaces. An electron beam at grazing incidence travels farther through a surface film in the first of these cases than in the others, and films 5 to 10 Å thick yield patterns. Results obtained on cleavage and rough surfaces of Zn and on electrolytically polished Al are discussed. M. R. HOPKINS

539.27

4388. Stereopictures in the electronmicroscope. R. RÜHLE. *Optik*, **5,** 534–48 (*Nov.–Dec.*, 1949) *In German.*

Describes a mechanical device for imparting the necessary motions to the object holder. Several examples of stereopictures taken with the device are included. A. H. W. BECK

539.27

4389. Study by means of electron diffraction of the oxidation of zinc surfaces prepared by cleavage or by evaporation. H. RAETHER. *J. Phys. Radium*, **11,** 11–19 (*Jan.*, 1950) *In French.*

539.27

4390. Reanalysis of the electron diffraction data on $Be(BH_4)_2$ and $Al(BH_4)_3$. S. H. BAUER. *J. Amer. Chem. Soc.*, **72,** 622–3 (*Jan.*, 1950).

539.27

4391. An electron diffraction investigation of the structures of neopentyl chloride and silico-neopentyl chloride. The determination of intensities through the use of a rotating sector. J. M. HASTINGS AND S. H. BAUER. *J. Chem. Phys.*, **18,** 13–26 (*Jan.*, 1950).

539.27

4392. The structure of polymer-plasticizer gels as shown by the electron microscope. W. R. RICHARD AND P. A. S. SMITH. Letter in *J. Chem. Phys.*, **18**, 230–1 (*Feb.*, 1950).

539.27

4393. A simple replica technique suitable for the study of surface structures. D. J. CRISP AND W. H. THORPE. Letter in *Nature, Lond.*, **165**, 273 (*Feb.* 18, 1950).

539.27

4394. On the formation of cubic Ce_2O_3 in the oxidation of cerium as evidenced by electron diffraction. R. COURTEL AND J. LORIERS. *C.R. Acad. Sci., Paris*, **230**, 735–7 (*Feb.* 20, 1950) *In French.*

539.27

4395. Single-step quartz imprints for investigations with an electron microscope. L. I. ZEMLYANOVA, YU. M. KUSHNIR AND A. I. FRIMER. *Dokl. Akad. Nauk, SSSR*, **70** (*No.* 6) 991–3 (1950) *In Russian.*

A method is described of obtaining high-quality single-layer quartz imprints of the surfaces of metallographic specimens of metals (steel, Al, Cu, Ni, brass, Ta and Mo). F. LACHMAN

539.27 : 539.133

4396. An electron-diffraction investigation of nitrogen trifluoride. V. SCHOMAKER AND C.-S. LU. *J. Amer. Chem. Soc.*, **72**, 1182–5 (*March*, 1950).

An electron-diffraction investigation of NF_3 has been made. The molecule may be represented by a symmetrical, pyramidal model with bond distance $r_{N-F} = 1{\cdot}37$ Å and bond angle $\angle FNF = 102{\cdot}5°$ ($r_{F \ldots F} = 2{\cdot}14$ Å). A simple interpretation, which should be applicable to other, analogous situations, is given for the very small dipole moment and relatively small bond angle of the NF_3 molecule, in contrast to the relatively large dipole moment and bond angle of the NH_3 molecule. A.

ELASTICITY . STRENGTH . RHEOLOGY
539.3/.8

539.31

4397. A revision of the theory of elasticity. F. D. MURNAGHAN. *An. Acad. Brasil. Ciênc.*, **21** (*No.* 4) 329–36 (1949).

A matrix notation is used in discussing the consequences of abandoning the hypotheses (i) that strains are infinitesimal, and (ii) that the initial configuration from which strain is measured is unstressed. The exact relation between stress and strain is given in the form $T = (\rho/\rho_0)J^*\phi_\eta J$, where T is the stress matrix, ρ_0 and ρ are the initial and final densities, J is the matrix whose elements are the derivatives of the final coordinates with respect to the initial coordinates, J^* is the transposed matrix, and ϕ_η is the gradient of the energy of deformation per unit volume (ϕ) with respect to the strain matrix (η). Good agreement between theory and experiment, in the case of Na subjected to hydrostatic pressures up to 10^5 atm., can be obtained by considering only 2nd and 3rd-order terms in the development of ϕ as a power series in the strains. J. G. OLDROYD

539.3

4398. Non-coaxiality of principal normal stresses and the "strain" ellipsoid in the classical theory of infinitesimal deformation. K. H. SWAINGER. Letter in *Nature, Lond.*, **165**, 159–60 (*Jan.* 28, 1950).

When the deformation of a body involves rotation of the body as a whole, an ambiguity can arise in the mathematical argument determining the principal directions of strain if the usual approximate expressions for infinitesimal strains in terms of spacial displacements are used. This is avoided by defining strain in terms of "straining-displacement". [See Abstr. 197 (1948)]. J. G. OLDROYD

539.32

4399. Dynamical properties of rubber and rubber-like materials in a large frequency range. W. KUHN AND E. MEYER. "*Noise and sound transmission*" 1948" (*Phys. Soc., Lond.*, 1949) 181–8.

The loss factor η for the hydrostatic compression of rubber was determined at (*a*) low frequencies by the change in the resonance frequency and the broadening of the resonance curve of a column of liquid on inserting a sample, (*b*) medium frequencies from measurements on standing waves in a liquid in which a disc is inserted at a pressure antinode, (*c*) high frequencies from absorption measurements assuming the velocity of sound. η varied from 0·03 at 1·2 kc/s to 0·08–0·15 at 10 Mc/s. Young's modulus E and the associated loss factor were determined at (*a*) low frequencies from the frequency response curve of forced longitudinal vibrations in a strip, (*b*) medium frequencies from transverse vibrations of a clamped disc, (*c*) high frequencies from the velocity and attenuation of longitudinal waves in a strip. E changes for Buna rubber by 34% per decade of frequency at 17°c and natural rubber with zinc oxide as filler by 15%. η is constant up to 20 c/s and then steadily increases. From torsional oscillations (0·2–0·3 c/s), the effect of static strain on and the rigidity modulus was determined. J. E. CAFFYN

539.32

4400. Elastic constants of sodium thiosulphate. R. V. G. SUNDARA RAO. *Proc. Indian Acad. Sci. A*, **30**, 302–7 (*Dec.*, 1949).

The 13 elastic constants have been determined by the ultrasonic method. They are, in units of 10^{11} dynes cm^{-2}, $C_{11} = 4{\cdot}57$, $C_{22} = 3{\cdot}31$, $C_{33} = 3{\cdot}02$, $C_{44} = 0{\cdot}60$, $C_{55} = 0{\cdot}57$, $C_{66} = 1{\cdot}11$, $C_{12} = 1{\cdot}84$, $C_{13} = 1{\cdot}68$, $C_{23} = 1{\cdot}83$, $C_{16} = -0{\cdot}69$, $C_{26} = +0{\cdot}25$, $C_{36} = +1{\cdot}04$, $C_{45} = -0{\cdot}27$. The corresponding s's have also been calculated. A.

539.32

4401. Some physical properties of titanium. H. I. FUSFELD AND J. T. GILBERT. Letter in *Phys. Rev.*, **77**, 303 (*Jan.* 15, 1950).

Young's modulus was measured acoustically for 4 samples of Ti rod. For 15 in lengths, E was $11{\cdot}24 \times 10^{11}$ dyne/cm^2, and for 20 in lengths $11{\cdot}15 \times 10^{11}$ dyne/cm^2. N. CORCORAN

539.32

4402. Evaluation of the stiffness coefficients for beryllium from ultrasonic measurements in polycrystalline and single crystal specimens. L. GOLD. *Phys. Rev.*, **77**, 390–5 (*Feb.* 1, 1950).

539.32 : 534.113

4403. A resonant bar method for determining the elastic properties of thin lamina. A. W. NOLLE AND P. J. WESTERVELT. *J. Appl. Phys.*, **21**, 304–6 (*April*, 1950).

Formulae are deduced for the calculation of Young's modulus of a thin cement layer from the measured resonant frequency and band width of two similar steel bars, cemented end-to-end. The accuracy of the method is discussed.

539.37

4404. Some chemical and physical properties of rubber. J. MOORE. *Brit. J. Appl. Phys.*, **1**, 6–9 (*Jan.*, 1950).

The chemical constitution and physical state of natural rubber in its viscous, high-elastic and crystalline conditions are described. On breaking down the cohesion between the hydrocarbon chains by various means, rubber has some of the characteristics of a thick oil; whilst, on the other hand, certain conditions, especially those of intense cooling, cause it to behave in many respects like a crystalline material. This concept is then extended to a consideration of other rubber-like materials including gutta percha, some synthetic elastomers and finally the silicone rubbers. A.

539.37 : 534.01

On small motions in not completely elastic bodies. *See Abstr.* 3850

539.374

4405. Influence of experimental conditions on the adsorption effect in facilitating the deformation of metallic monocrystals. P. A. REBINDER AND V. I. LIKHTMAN (LICHTMAN). *Dokl. Akad. Nauk, SSSR*, **69** (*No.* 2) 219–22 (1949) *In Russian.*

See Kemsley [Abstr. 5776 (1949)]. It has been shown that it is advisable not to use the method of stretching at a constant speed but rather the more universal method of "creeping," i.e. flow under a constant load. F. LACHMAN

539.374

4406. Note on the role of rifting in cold-work and a possible measure of plastic deformation. D. P. SMITH. *J. Appl. Phys.*, **20**, 1186–7 (*Dec.*, 1949).

A hypothesis is put forward that plastic deformation of a metallic lattice under compression is preceded by minor irreversible deformations, which take the form of localized rifts in the lattice. In metals such as Fe and Ni, rifts are opened by H penetration, although there is evidence that H does not penetrate into the normal lattice. At given H-pressure and (sufficiently high) temperature, each metal has a definite solubility for H, which suggests that a metallic crystal has a well-defined rift system. At lower temperatures, the occlusive capacity of the metal is highly dependent on the degree and manner of previous plastic deformation. Occlusive capacity for H at room temperature may be made to serve as a quantitative measure of the degree of cold-working. J. G. OLDROYD

539.374

4407. Bending of an ideal plastic metal. J. D. LUBAHN AND G. SACHS. *Trans. Amer. Inst. Elect. Engrs*, **72**, 201–8 (*Feb.*, 1950).

539.379.4

4408. One-dimensional dislocations. IV. Dynamics. F. C. FRANK AND J. H. VAN DER MERWE. *Proc. Roy. Soc. A*, **201**, 261–8 (*March* 22, 1950).

The equations of motion of the one-dimensional dislocation model are studied, and all solutions representing disturbances propagated without change of form are obtained. These comprise: (i) dislocations, and regular sequences of the same, either of like or of alternating sign, travelling with velocity $< c$, the characteristic wave velocity of the system; (ii) anti-dislocations, and sequences of the same, travelling with velocity $> c$; and (iii) waves of infinitesimal amplitude, belonging to two branches travelling respectively with velocities $<$ and $> c$. Only dislocations or sequences of dislocations of like sign, and waves of velocity $< c$, correspond to stable equilibria. The dislocations exhibit "relativistic" behaviour. The relevance of anti-dislocations to very fast slip in solids is considered, and rejected. A.

539.383

4409. Derivation by statistical mechanics of the law of dependence of the compressibility of solids on temperature. P. G. BORDONI. *Atti. Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **6**, 597–602 (*May*, 1949) *In Italian.*

An analysis based on the equation of state leads to an explicit expression for the compressibility. Numerical values given by this formula are compared with experimental values for several metals. The agreement is good. L. S. GODDARD

539.386

4410. Metal transfer in the cutting process. M. C. SHAW AND C. D. STRANG, JR. Letter in *J. Appl. Phys.*, **21**, 349–50 (*April*, 1950).

539.42

4411. Strength properties of polymers in an oriented state. A. V. STEPANOV. *J. Exp. Theor. Phys., USSR*, **19**, 973–88 (*Nov.*, 1949) *In Russian.*

New conceptions concerning the phenomena of disruption of solids. Griffith's ideas are only of limited application, viz. to the case of isotropic elastic bodies. The possible cases of development of localized areas of disruption are considered for elastic anisotropic bodies. These areas may present different aspects, characteristic examples of which are "cracks" and "crumbling." Development is not always gradual; the breakdown of the structure then becoming spontaneous. The latter case is the one described by theory, which then agrees with experimental findings. Examples include flax, asbestos and other oriented polymers. B. F. KRAUS

539.434

4412. A high sensitivity torsion creep unit. A. E. JOHNSON. *J. Sci. Instrum.*, **27**, 74–5 (*March*, 1950).

539.62

4413. The importance of surface oxide films in the friction and lubrication of metals. I. The dry friction of surfaces freshly exposed to air. II. The formation of lubricating films on metal surfaces. E. D. TINGLE. *Trans. Faraday. Soc.*, **46**, 93–102 (*Feb.*, 1950).

539.62

4414. Surface deformation and friction of metals at light loads. J. R. WHITEHEAD. *Proc. Roy. Soc. A*, **201**, 109–24 (*March* 7, 1950).

A study has been made of the interaction of sliding metals when the normal load between them is very small. An apparatus is described which enables friction to be measured, under controlled conditions of sliding, down to loads of a few mg. The deformation of the sliding surfaces has been studied by light and electron microscopy. These techniques have been used to investigate the validity of Amontons's law (proportionality of frictional force to load) over a very wide range of loads, from a few mg to several kg. Experimental results on electrolytically polished Cu reveal a departure from Amontons's law when the normal load is $<$ a few g. The results of further experiments show that the friction of Ag on Ag and of Al on Al is constant and Amontons's law holds over the whole range of loads. It appears that the thin film of oxide on aluminium is penetrated, even at the lightest loads. The results are discussed in relation to those for Cu, and the difference in behaviour of the various metals is attributed to the contrasting properties of their oxides. Isolated experiments on sapphire and diamond show that the coefficient of friction is low and constant for these non-metals, and a few experiments made on boundary lubricated metals are recorded. A.

539.67

4415. Application of the methods of non-linear mechanics to the calculation of the dissipation of energy in a material under oscillations. G. S. PISARENKO. *J. Tech. Phys., USSR*, **19**, 1408–22 (*Dec.*, 1949) *In Russian.*

An approximation method of non-linear mechanics is applied to the problem of finding the resonance curve of an oscillating elastic system, considering energy dissipation, i.e. damping. The energy dissipated per unit volume is assumed as a characteristic of the material, independent of its shape and dimensions. The method consists essentially in an expansion in terms of a small parameter. This is applied to the special case of a cantilever with an axial tensile force applied to its end. B. F. KRAUS

PHYSICAL CHEMISTRY 541

PHASE EQUILIBRIUM . CHEMICAL REACTIONS 541.11/.12

541.123.3

4416. Thermodynamic tests for vapour-liquid equilibrium data on ternary systems with some comments on extractive distillation. E. F. G. HERINGTON. *Research, Lond.*, **3**, 41–6 (*Jan.*, 1950).

Methods for testing the internal consistency of isothermal data on the vapour-liquid equilibria in 2-phase ternary systems are developed by an argument based on thermodynamics and it is shown how these tests can be extended to the study of isobaric data. An average value of the log of the relative volatility ratio for 2 components at a fixed mol. fraction of the third is defined and equations for calculating this quantity from binary data are deduced. This function is a useful guide to the choice of a third component in extractive distillation. A.

541.124 : 533.77

4417. On thermal reactions in the gas phase. II. E. KANAI. *Progr. Theor. Phys.*, **4**, 171–80 (*April–June*, 1949).

Theoretical. The author's treatment [Abstr. 7341 (1949)] is applied to reactions of the second order. Reactions of the "exchange" type, $A + B \rightarrow C + D$, and of the "associative" type, $A + B \rightarrow C$, are dealt with separately, the collision process being treated along quantum-mechanical lines (A, B, C and D may be atoms, molecules or ions, but the case where A and B are *both* atoms is excluded). The activated complex is regarded as a kind of radioactive molecule. S. J. GREGG

541.126

4418. Mechanism of detonation. H. H. M. PIKE. *Nature, Lond.*, **165**, 214–16 (*Feb.* 11, 1950).

A report of a discussion by the Royal Society in November, 1949, in which work carried out during and since the last war was reviewed. The discussion ranged over theory, observational techniques and the phenomena of initiation. Following reviews of pre-war and war-time theoretical work, Jones outlined a recent generalization of the Chapman–Jouguet condition: by applying in (P, V, V_0) space a condition analogous to that of Chapman and Jouguet in (P, V) space (where P, V are pressure and specific volume of the products of detonation and V_0 the specific volume of the unreacted explosive) a new method of determining detonation pressures is indicated. High-speed mirror cameras with writing speeds of from 1 mm/μsec to over 4 mm/μsec were described; by electronic methods, however, writing speeds of 24 mm/μsec have been reached. Initiation phenomena discussed included the mechanism of initiation of sensitive and normal explosives, the existence of low-order detonations in the build-up of the detonation wave, and the passage of a detonation wave from one explosive to another. A. SCHOFIELD

ELECTROCHEMISTRY 541.13

541.133

4419. Measurement of conductivity at high frequencies. I. A. CARRELLI AND L. RESCIGNO. *Nuovo Cim.*, **7**, 1–8 (*Jan.*, 1950) *In Italian.*

Measurements for 5 salts at $f = 4.47 \times 10^7$ sec^{-1} are given.

541.135

4420. Estimation of solvation of ions in a solution from kinetic theory. H. MUKHERJEE. *Indian J. Phys.*, **23**, 503–7 (*Nov.*, 1949).

541.135

4421. On a system of integro-differential equations describing non-stationary phenomena in electrolytes. M. DRĂGANU. *J. Phys. Radium.* (*Sér.* 8) **10,** 342–8 (*Nov.*, 1949) *In French.*

A statistical theory of ions in electrolytic solutions is set up. The ions are characterized by their chemical type and their kinetic energy. The effect of collisions is considered. The mathematical analysis is somewhat heavy, but it leads to a set of equations alternative to those of Debye and Falkenhagen [*Phys. Z.*, **29,** 401 (1928)], and these promise better results in particular cases. L. S. GODDARD

541.135

4422. Macroscopic space charge in electrolytes during electrolysis. D. A. MACINNES, T. SHEDLOVSKY AND L. G. LONGSWORTH. Letter in *J. Chem. Phys.*, **18,** 233–4 (*Feb.*, 1950).

Criticism of Reed and Schrievers' results [Abstr. 2751 (1950)].

541.135

4423. Electric potential of solutions as a cause of the formation of Liesegang rings. A. CHRISTOMANOS. Letter in *Nature, Lond.*, **165,** 238–9 (*Feb.* 11, 1950).

541.135 : 537.221

4424. The contact between a solid and an electrolyte. T. B. GRIMLEY. *Proc. Roy. Soc. A*, **201,** 40–61 (*March* 7, 1950).

The theory of the double layer is developed for plate-like crystals, and equations are derived which relate the potential drop in each phase and the total charge on the double layer to the physical constants of the system. The theory is applied to AgBr in contact with an electrolyte. A.

541.135.5

4425. The behavior of glass electrodes in acid solutions. E. E. SINCLAIR AND A. E. MARTELL. *J. Chem. Phys.*, **18,** 224–7 (*Feb.*, 1950).

541.135.5

4426. Cathodic evolution of hydrogen at very high current densities. A. M. AZZAM AND J. O'M. BOCKRIS. Letter in *Nature, Lond.*, **165,** 403–4 (*March* 11, 1950).

PHOTOCHEMISTRY . RADIATION CHEMISTRY 541.14

541.14

4427. The polymerization of vinyl chloride by α-radiation. W. MUND, J. A. HERMAN AND G. VERFAILLIE. *Bull. Acad. Roy. Belge. Cl. Sci.*, **35** (*No.* 7) 656–68 (1949) *In French.*

This has been investigated quantitatively under different experimental conditions, using rays from Rn. W. R. ANGUS

541.14

4428. Polymerization induced by nuclear radiations. A. CHAPIRO, C. COUSIN, Y. LANDLER AND M. MAGAT. *Rec. Trav. Chim. Pays-Bas*, **68,** 1037–69 (*Dec.*, 1949) *In French.*

Primary production of free radicals in *n*-induced polymerization is by the Szilard–Chalmers effect, but disintegration β- and γ-rays contribute almost as much (about 10%). By far the largest source is in collisions between atoms of high energy, expelled in slow-neutron capture, and other molecules present. The rate of polymerization induced by Ra-γ-rays varies greatly with the monomer, being lowest for butadiene and styrene, and highest for vinyl acetate. It is increased by the addition of small amounts of other organic liquids, e.g. CCl_4 to styrene. These rate increases are found to be related to an increase in molecular weight and cannot be explained in terms of the number of free radicals formed. Various mechanisms are discussed. The number of free radicals formed by irradiation is of the same order as the number of ion-pairs produced. C. B. ALLSOPP

541.14

4429. The effect of X- and γ-rays on aqueous solutions of sodium thymonucleate. G. C. BUTLER. *Canad. J. Res. B*, **27,** 972–87 (*Dec.*, 1949).

541.14

4430. The photolysis of methyl iodide. R. D. SCHULTZ AND H. A. TAYLOR. *J. Chem. Phys.*, **18,** 194–7 (*Feb.*, 1950).

541.14

4431. Primary step in the mercury photo-sensitized decomposition of propane and of hydrogen. C. R. MASSON AND E. W. R. STEACIE. *J. Chem. Phys.*, **18,** 210–12 (*Feb.*, 1950).

541.141

4432. Quantitative studies of radiation-induced reactions in aqueous solution. I. Oxidation of ferrous sulfate by X- and γ-radiation. N. MILLER. *J. Chem. Phys.*, **18,** 79–87 (*Jan.*, 1950).

541.142 : 539.163

4433. Chemical effects accompanying the decay of Mn^{51}. W. H. BURGUS AND J. W. KENNEDY. *J. Chem. Phys.*, **18,** 97–105 (*Jan.*, 1950).

An investigation has been made of the chemical forms assumed by Cr^{51} when it is produced by positron decay of Mn^{51} under a variety of conditions. The data have shown that the oxidation state of the parent Mn^{51} plays an important role in determining the oxidation state of daughter Cr^{51}. By variation of experimental conditions some information has been obtained regarding the types of chemical reactions undergone by the Cr^{51}. These reactions have also been shown to play important roles in determining the ultimate chemical form of daughter Cr^{51}. The complexity of the factors determining the chemical forms of Cr^{51} after Mn^{51} decay has been pointed out, and possible explanations of some of the observed phenomena have been suggested. It is believed that the results are consistent with the hypothesis that appreciable ionization in the valence shell accompanies the β-decay process. It has been demonstrated that the Mn isotope of 44 min $\frac{1}{2}$-life (Mn^{51}) decays to the chromium isotope of 26 d $\frac{1}{2}$-life (Cr^{51}). A.

DISPERSIONS . COLLOIDS . ADSORPTION 541.18

541.18 : 538

4434. Influence of a magnetic field on colloidal sulphur. O. TANAEVSKY. *C.R. Acad. Sci., Paris*, **230,** 541–3 (*Feb.* 6, 1950) *In French.*

541.182.025

4435. Thixotropic behavior of carbon black in rubber. L. MULLINS. *J. Phys. Coll. Chem.*, **54**, 237–51 (*Feb.*, 1950).

541.182.3

4436. Preliminary study of some metallic oxide smokes with electron microscope. A. K. CHAUDHURY AND M. L. DE. *Indian J. Phys.*, **23**, 430–2 (*Nov.*, 1949).

The structures of the oxide smokes of Mg, Zn, Mo and W have been examined. An attempt has been made to correlate the results obtained with those obtained from X-ray studies. A.

541.182.32

4437. Diffusional boundary value problems involving moving boundaries, connected with the growth of colloidal particles. H. REISS AND V. K. LA MER. *J. Chem. Phys.*, **18**, 1–12 (*Jan.*, 1950).

A method is suggested for treating problems of diffusion which involve moving boundaries. It is applicable when the flux of material through any surface in the diffusion field is $\gg$ than the rate of change of concentration on that surface. The method is applied to two problems dealing with the growth of monodispersed aerosols and hydrosols. A.

541.182.6

4438. New method for studying electrical orientation and relaxation effects in aqueous colloids: preliminary results with tobacco mosaic virus. C. T. O'KONSKI AND B. H. ZIMM. *Science*, **111**, 113–16 (*Feb.* 3, 1950).

541.182.6

4439. Preparation of colloidal silver-iodide water-suspensions for nucleation of supercooled clouds. E. KATCHALSKY AND H. NEUMANN. Letter in *Nature, Lond.*, **165**, 244–5 (*Feb.* 11, 1950).

541.183

4440. Physical and chemical adsorption of long chain compounds on metals. F. P. BOWDEN AND A. C. MOORE. Letter in *Research, Lond.*, **2**, 585–6 (*Dec.*, 1949).

541.183

4441. The activity coefficient of surface-active materials in aqueous solutions. H. M. SCHOLBERG. *J. Phys. Coll. Chem.*, **54**, 107–14 (*Jan.*, 1950).

541.183

4442. Effect of molecular size on sorption hysteresis. M. J. BROWN AND A. G. FOSTER. Letter in *Research, Lond.*, **3**, 97 (*Feb.*, 1950).

541.183

4443. A radioactive method for measuring the adsorption of dissolved substances on liquid surfaces. G. ANIANSSON AND O. LAMM. Letter in *Nature, Lond.*, **165**, 357–8 (*March* 4, 1950).

541.183 : 532.64

4444. Wettability, a function of the polarizability of the surface ions. L. R. SONDERS, D. P. ENRIGHT AND W. A. WEYL. *J. Appl. Phys.*, **21**, 338–44 (*April*, 1950).

The wettability of crystals, glasses and even of water itself can be temporarily decreased by bringing ions of high polarizability into their surfaces. Base exchange experiments are described where the hydrogen ions present in the surface layers of bentonite (a clay mineral of high exchange capacity) and of a soda-lime glass are replaced by different cations. This substitution seems to have no particular effect on the hydrophilic and rheological properties of the carriers as long as their surfaces are kept in contact with water. After drying, however, the surfaces which contain ions of high polarizability become hydrophobic, at least temporarily. A porous clay film will no longer absorb water instantaneously after having been treated with Ni^{2+}, Mn^{2+}, Hg^{2+} or similar ions with incomplete outer electron shells. Contact angles with water up to 70° could be observed for a short period for Hg^{2+} and Pb^{2+} clays. Glass capillary tubes which have been treated with non-noble-gas-type ions show a capillary rise which is much smaller than that observed with the tubes which have been treated with HCl and water only. This depression of the capillary rise, too, is temporary and can be observed only if the glass wall has been thoroughly dried previous to the experiment and if the capillary rise is measured in the upward direction. An explanation is presented for these and allied phenomena on the basis of the polarization of ions in the strongly asymmetrical forcefields of interfaces. The experiments are correlated with the hysteresis of the contact angle and with observations concerning adhesion phenomena and catalytic activities of heavy metal ions at interfaces. A.

541.183.25

4445. Photo-colorimetric study of adsorption by carbon black. J.-J. TRILLAT AND J. MILLET. *J. Rech. Cent. Nat. Rech. Sci.* (*No.* 10) 32–5 (1950) *In French.*

The adsorption of oil by carbon blacks is studied by the following process: (*a*) a weighed quantity of C is shaken with a dilute solution of the oil in a solvent such as benzene and toluene; (*b*) the C is filtered off and the solution examined in a photocolorimeter. The extinction coefficient of the solution before and after treatment with C is measured, and since the solutions are sufficiently dilute for the Lambert–Beer law to hold, the change in oil concentration is given directly. Results are given for the adsorption of tar oil by various blacks. Curves show the effect of varying the amount of C and the concentration of the oil. J. IBALL

CHEMICAL STRUCTURE 541.4/.6

541.64

4446. The effect of chain length on the intrinsic viscosity-temperature coefficient of linear high polymers. L. H. CRAGG AND J. E. SIMKINS. *Canad. J. Res. B*, **27**, 961–71 (*Dec.*, 1949).

Careful measurements of the intrinsic viscosities of 3 fractions of polystyrene, ranging in molecular weight from 160 000 to 1 350 000, have been made over a 40°c range of temperature in a good solvent (toluene) and a poor one (toluene—30% 1-butanol). These, together with similar but somewhat less accurate measurements with 5 fractions of GR-S, show clearly that solvent effects on the intrinsic viscosity are strongly dependent on molecular weight for linear flexible polymers, and give additional support to the concept that the differences in the intrinsic viscosity of such a polymer in good or poor solvents are due

primarily to differences in the looseness or tightness of coiling of its flexible molecules in solution. A.

541.64

4447. Size, viscosity and precipitation of polymer molecules in solution. E. D. KUNST. *Rec. Trav. Chim. Pays-Bas*, **69**, 125–40 (*Jan.*, 1950).

541.64

4448. Use of inequalities in polymer research. G. HERDAN. *Research, Lond.*, **3**, 35–41 (*Jan.*, 1950).

The differences between m.w. averages of polymers obtained by different methods of determination are interpreted in terms of inequalities, and the relationship between these inequalities and the degree of polydispersity is shown. A.

541.64

4449. Statistical mechanics of swelling of network structures. P. J. FLORY. *J. Chem. Phys.*, **18**, 108–11 (*Jan.*, 1950).

Inaccuracies in previously published theories dealing with the swelling of network polymers in solvents are pointed out. In the present paper the entropy of swelling a network of any degree of connectivity, or functionality f, is derived in a manner which avoids these inaccuracies. Corrected relationships are given for the partial molal-free energy of dilution, swelling equilibrium and the influence of deformation on swelling equilibrium. These differ appreciably from those previously given when the degree of interlinking (i.e. concentration of cross linkages if $f = 4$) is large and the equilibrium degree of swelling therefore is small. Previous expressions for elastic deformation at constant volume are unaffected. A.

541.64

4450. Note on the influence of structure on internal pressure in polymeric systems. P. J. FLORY. *J. Chem. Phys.*, **18**, 112–13 (*Jan.*, 1950).

541.64

4451. Light-scattering measurement of interactions between unlike polymers. W. H. STOCKMAYER AND H. E. STANLEY. Letter in *J. Chem. Phys.*, **18**, 153–4 (*Jan.*, 1950).

541.64

4452. The entropy of high polymer solutions. A. J. STAVERMAN. *Rec. Trav. Chim. Pays-Bas*, **69**, 163–74 (*Feb.*, 1950).

541.64

4453. An estimate of the volume effect in coiling long chain molecules. J. J. HERMANS. *Rec. Trav. Chim. Pays-Bas*, **69**, 220–4 (*Feb.*, 1950).

541.64

4454. Recent progress in emulsion polymerization. H. MARK. *Rec. Trav. Chim. Pays-Bas*, **69**, 243–6 (*Feb.*, 1950).

541.64 : 532.73

Experimental study of the Maxwell effect of solutions of chain macromolecules as a function of solvent viscosity. *See Abstr.* 3828

541.64 : 534.25

The acoustic birefringence of macromolecular solutions. *See Abstr.* 3864

541.65 : 537.531 : 535.43

4455. X-ray investigation of chain-molecules in solution. O. KRATKY AND G. POROD. *Rec. Trav. Chim. Pays-Bas*, **68**, 1106–22 (*Dec.*, 1949) *In German.*

Four regions can be identified in the X-ray scattering curves for chain-molecules in solution. They are attributed respectively to diffraction by the whole coiled molecule; to parts of the molecule which lie in all possible orientations; to straight parts of the molecule; and to smaller parts of the molecule e.g. monomer group or single atoms. It is shown that the intersection point of the second and third of these regions is characteristically connected with the statistical chain element or "length of persistence," a measure of the stiffness of the chain molecule. Measurements with polyvinyl bromide and with cellulose nitrate gives values 11 Å and 150 Å respectively for this quantity, in agreement with other methods.

C. B. ALLSOPP

541.66 : 536.63

Heat capacity and chemical constitution. *See Abstr.* 4033

LABORATORY APPARATUS 542.1/.7

542.2

4456. Positive displacement pump for corrosive fluids. E. E. GLENN, JR. AND N. HACKERMAN. *Rev. Sci. Instrum.*, **21**, 148–9 (*Feb.*, 1950).

CHEMICAL ANALYSIS 543/545

543/545

4457. Second annual review of analytical chemistry: fundamental analysis. *Analyt. Chem.*, **22**, 2–136 (*Jan.*, 1950).

Series of 26 review articles with comprehensive lists of references. Subjects discussed include spectroscopy (absorption, infrared, Raman, ultra-violet, X-ray), mass-spectroscopy, electron-microscopy and chemical methods of analysis.

545.3

4458. L & N bibliography of polarographic literature. *Philadelphia, Leeds and Northrup Company* (1950) 102 *pp.*

Three extensive lists of references, based on chronology, authors and subjects.

545.38

4459. Application of radio-frequencies to conductimetric analysis (rectified radio-frequency method). G. G. BLAKE. *Analyst*, **75**, 32–7 (*Feb.*, 1950).

Small changes in the conductivity of solutions, e.g. those associated with neutralization, as in conductimetric titration, can with advantage be measured by means of r.f. oscillations. A recent form of apparatus is described, in which the liquid under test is drawn up into a conductimetric tube around which are three sleeve electrodes; after traversing the liquid in the tube the oscillatory current is rectified and measured with a micro-ammeter. All complications and disturbances due to contact of electrodes with the liquid are avoided. Examples of titration curves are illustrated. A.

545.721

4460. An apparatus for determining oxygen magnetically in gas mixtures. E. LEHRER AND E. EBBINGHAUS. *Z. angew. Phys.*, **2** (*No.* 1) 20–4 (1950) *In German.*

Constructional and operational features are given of a recording apparatus for estimating oxygen in technical gas mixtures. W. R. ANGUS

545.8 : 539.185

4461. Neutron spectroscopy for chemical analysis. I. T. I. TAYLOR AND W. W. HAVENS, JR. *Nucleonics*, **5**, 4–18 (*Dec.*, 1949).

A brief discussion of the general properties of neutrons and their interaction with matter is given and the properties which can form a basis for analysis of materials are indicated. Thus, absorption cross-sections in the thermal region may be used to analyse simple systems, large resonance cross-sections can be used for quantitative identification of certain elements, analysis of H compounds can be based on the large increase in the thermal neutron scattering cross-sections of H in the bound state, neutron diffraction patterns can be used to identify crystals or to determine their structure. Accurate measurements require the isolation of well-defined energy groups by some form of spectrometer. Several neutron spectrometers are described. L. R. SHEPHERD

545.82

4462. The application of radioactive ionization to spectrochemical analysis. E. SÁNCHEZ SERRANO. *Rev. Geofis.*, **8**, 388–403 (*April–Sept.*, 1949) *In Spanish*

It is suggested that ionization produced by radioactive substances may be used to improve the constancy and reproducibility of the electric discharge employed in spectrochemistry. L. PINCHERLI

545.8

4463. The spectro-chemical determination of carbon in ferrous alloys. K. C. MAZUMDER AND M. K. GHOSH. *Indian J. Phys.*, **23**, 477–82 (*Nov.*, 1949).

545.82 : 621.385.84

4464. An application of Geiger counter tubes for spectrochemical analysis. O. G. KOPPIUS. *Philips Tech. Rev.*, **11**, 215–19 (*Jan.*, 1950).

A spark discharge is maintained between two Cu electrodes in the air of a plant where atmospheric contamination with Pb or Pb compounds can occur through possible leaks in plant installations. If Pb is present the spark will contain the Pb line at 2 203 Å. By a small quartz spectrograph provided with a movable slit in its focal plane, this spectral line is isolated and its intensity is measured by a photoelectric Geiger counter tube with counting-rate meter. The sensitivity of the apparatus in normal operation is limited to about 0·60 mg Pb/m³ air, by the fluctuations of the background intensity emitted by the spark. Although this is more than the max. permissible concentration of Pb in the air (0·15 mg/m³), the instrument has proved very useful as a means for detecting and locating small leaks in pipes or valves in whose vicinity high Pb concentrations may occur. A.

545.822

4465. Mass spectra of C_5H_8 isomers. F. L. MOHLER, E. G. BLOOM, L. WILLIAMSON, C. E. WISE AND E. J. WELLS. *J. Res. Nat. Bur. Stand., Wash.*, **43**, 533–6 (*Dec.*, 1949).

CRYSTALLOGRAPHY 548

548.0 : 535

4466. Optical studies of barium titanate crystals. L. E. CROSS, A. T. DENNISON AND M. M. NICOLSON. *Proc. Leeds Phil. Lit. Soc.*, **5**, 199–206 (*Dec.*, 1949).

Pseudo-cubic crystals of $BaTiO_3$ have been prepared and their optical properties examined under the polarizing microscope. The crystals have complex twin patterns which, owing to the ferroelectric spontaneous polarization, can be changed by the application of suitable electric fields. The transition from tetragonal to cubic symmetry at the Curie temperature has been observed, together with a raising of this temperature by an external electric field, as would be expected by analogy with the ferromagnetic case. A further transition has been observed at approximately 0°c where there appears to be a reduction in crystal symmetry. A.

548.0 : 535.323

4467. Optics of ethylenediamine tartrate at elevated temperatures. E. G. STEWARD. Letter in *Nature, Lond.*, **165**, 406–7 (*March* 11, 1950).

548.0 : 535.43

4468. Thermal scattering of light in quartz. R. S. KRISHNAN AND V. CHANDRASEKHARAN. *Nature, Lond.*, **165**, 406 (*March* 11, 1950).

548.0 : 537

4469. Color centers in calcium fluoride and barium fluoride crystals. A. SMAKULA. Letter in *Phys. Rev.*, **77**, 408–9 (*Feb.* 1, 1950).

548.0 : 537.226

4470. A theory of dielectric polarization in alkali-halide crystals. S. ROBERTS. *Phys. Rev.*, **77**, 258–63 (*Jan.* 15, 1950).

A theory of dielectric polarization is described in which each ion in an alkali-halide crystal is considered as a separate entity capable of being distorted internally by an electric field. 3 stiffness coefficients suffice to describe the interaction between the local electric field and the polarizable ion. The Lorentz internal field is shown to be valid for this calculation. Optical and dielectric polarizabilities per molecule and infra-red absorption frequencies in alkali-halide crystals calculated by this method are shown to be in substantial agreement with experiment. Electronic polarizabilities of free (gaseous) ions are also calculated, and a novel "pseudo-piezoelectric" effect is predicted. A.

548.0 : 539

4471. The specific energy of crystal boundaries in tin. K. T. AUST AND B. CHALMERS. *Proc. Roy. Soc. A*, **201**, 210–15 (*March* 22, 1950).

Specimens of Sn, consisting of 3 crystals of pre-

determined orientations, were prepared with various differences of orientation between 2 of the crystals. The equilibrium angles between the 3 boundaries were measured. Relative values of specific surface free energy were deduced from the angles, and it was found that the surface energy decreases progressively as the difference of orientation decreases below about 9°. The curve relating surface energy with differences of orientation extrapolates to zero surface energy at zero angle. The result is considered to provide strong support for the "transitional lattice" theory of the crystal boundary. A.

548.08 : 535.8

4472. A new double-Websky-signal for two-circle optical goniometers. W. G. PERDOK. *Appl. Sci. Res.*, **B1** (*No.* 5) 391–6 (1950).

To obtain the dark segments in the field, partially crossed half-circles of polaroid have been employed instead of leaf-shaped metal plates, which are more difficult to construct and to adjust. A.

548.4

4473. Disorder in crystals of non-metals. M. J. BUERGER. *An. Acad. Brasil Ciênc.*, **21** (*No.* 4) 245–66 (1949).

A review. The theory is developed and applied particularly to chalcopyrite, stannite, chalcocite, digenite, bornite, silica, and nepheline. A. J. C. WILSON

548.52

4474. Some observations of the epitaxy of sodium chloride on silver. G. W. JOHNSON. Letter in *J. Chem. Phys.*, **18**, 154–5 (*Jan.*, 1950).

548.522

4475. On the interpretation of the "vapor snake" in freezing cyclohexane. F. C. FRANK. Letter in *J. Chem. Phys.*, **18**, 231–2 (*Feb.*, 1950).

See Abstr. 1344 (1950).

548.523 : 538.69

4476. Action of a magnetic field on the crystallization of β-naphthol. J. BLANDIN. *C.R. Acad. Sci., Paris*, **229**, 1015–16 (*Nov.* 15, 1949) *In French.*

An extension of earlier work [Abstr. 1339 (1950)] to the differences in behaviour when a supersaturated solution of β-naphthol crystallizes without an applied magnetic field and under the influence of a horizontal field of 15 000 gauss. W. R. ANGUS

548.526

4477. Oriented growth of silver in silver halide crystallites. D. W. PASHLEY. *Acta Cryst.*, **3** (*No.* 3) 163–4 (1950).

Oriented layers of AgCl and AgBr formed by condensation are decomposed under electron bombardment. In AgCl layers, the Ag grows at first orientated parallel to the chloride; in the bromide there is a greater tendency to polycrystalline Ag formation. Halide layers formed chemically on Ag single crystals are stable to an electron beam. When reduced by developer the Ag grows mainly parallel to the large Ag crystals. J. A. FRANKS

MOLECULAR AND X-RAY CRYSTALLOGRAPHY 548.7

548.7

4478. Note on the derivation of the frequency spectrum of a crystal from specific heat measurements. H. GRAYSON-SMITH AND J. P. STANLEY. Letter in *J. Chem. Phys.*, **18**, 236 (*Feb.*, 1950).

548.733

4479. On adapting a powder X-ray diffraction camera for reflection patterns. J. PARSONS. *Rev. Sci. Instrum.*, **17**, 185–6 (*Feb.*, 1950).

A method is described by which a commercial X-ray diffraction powder camera, designed to take rod or tubular mounts, may be easily adapted to accommodate small, flat mounts. Provision is made to change the customary continuous rotation to that of 10° rotary oscillation. A.

548.734

4480. X-ray determination of mirror planes and rotation axes. A. J. C. WILSON. Letter in *Research, Lond.*, **3**, 48–9 (*Jan.*, 1950).

548.735

4481. A rapid approximate method for correcting low-angle scattering measurements for the influence of the finite height of the X-ray beam. R. E. FRANKLIN. *Acta Cryst.*, **3** (*No.* 3) 158–9 (1950).

548.735

4482. The systematic calculation of interplanar spacings or values of $\sin^2\theta$ with punched cards. J. DONOHUE. *Acta Cryst.*, **3** (*No.* 3) 161–2 (1950).

548.735

4483. Errata in Lonsdale's structure factor tables. K. LONSDALE. *Acta Cryst.*, **3** (*No.* 3) 162–5 (1950).

548.735.44

4484. A Hollerith punched-card method for the evaluation of electron density in crystal structure analysis. E. G. COX, L. GROSS AND G. A. JEFFREY. *Proc. Leeds Phil. Lit. Soc.*, **5**, 1–14 (*Dec.*, 1947).

548.736

4485. The X-ray scattering from a hindered rotator. M. V. KING AND W. N. LIPSCOMB. *Acta Cryst.*, **3** (*No.* 3) 155–8 (1950).

An expression is derived for the X-ray scattering from a crystal containing groups of atoms in hindered rotation about fixed axes. A Maxwell–Boltzmann distribution of the orientation angles of the groups is assumed, with a sinusoidally varying hindering potential. Although a corresponding expression is not derived for the hindered rotator without a fixed axis, it is shown that structure-factor data in the particular case of perfluorocyclohexane lead to the conclusion that the molecule is not a free rotator in the crystal, but either may be a hindered rotator or may show orientational disorder. A.

548.736.1

4486. The structure of cerium at the temperature of liquid air. A. F. SCHUCH AND J. H. STURDIVANT. Letter in *J. Chem. Phys.*, **18**, 145 (*Jan.*, 1950).

548.736.5

4487. Unit cell and space group of djalmaite. E. TAVORA. *An. Acad. Brasil Ciênc.*, **21** (*No.* 4) 337–50 (1949) *In Portuguese.*

548.736.5

4488. Mixed bismuth oxides with layer lattices. I. The structure type of $CaNb_2Bi_2O_9$. B. AURIVILLIUS. *Ark. Kemi*, **1**, *Paper* 54, 463–80 (1949).

548.736.5

4489. Mixed bismuth oxides with layer lattices. II. Structure of $Bi_4Ti_3O_{12}$. B. AURIVILLIUS. *Ark. Kemi*, **1**, *Paper* 58, 499–512 (1949).

548.736.5

4490. The structure of the paramolybdate ion. I. LINDQVIST. *Acta Cryst.*, **3** (*No.* 3) 159–60 (1950).

548.736.6

4491. A cleavage step on mica with a height that is a half-integral multiple of the crystal lattice spacing. J. S. COURTNEY-PRATT. Letter in *Research, Lond.*, **3**, 47–8 (*Jan.*, 1950).

548.736.6

4492. On the structure cell of chrysotile asbestos. N. N. PADUROW. *Acta Cryst.*, **3** (*No.* 3) 204–8 (1950) *In German.*

548.737

4493. Unit cell and space group of the *L* form of α-benzene hexachloride. O. HASSEL AND E. W. LUND. Letter in *Research, Lond.*, **2**, 588–9 (*Dec.*, 1949).

548.737

4494. The crystal structure of urea-hydrocarbon and thiourea-hydrocarbon complexes. A. E. SMITH. Letter in *J. Chem. Phys.*, **18**, 150–1 (*Jan.*, 1950).

548.737

4495. X-ray structure analysis of complex organic compounds. J. D. DUNITZ. *Research, Lond.*, **3**, 6–12 (*Jan.*, 1950).

548.7

4496. The crystal structure of di-fructose strontiu chloride tri-hydrate. P. F. EILAND AND R. PEPINSK *Acta Cryst.*, **3**, 160–1 (1950).

548.

4497. On the construction of a reflection system f single crystal electron diffraction. D. KOSSEL. *Opti* **5**, 53–79 (*April*, 1949) *In German.*

Various phenomena observed in single cryst electron diffraction—Laue circles, Kikuchi line Kikuchi parabolae—are explained with the aid of geometrical reciprocal lattice construction.

J. THEWL

548.

4498. Theory of the "forbidden" (222) electr reflection in the diamond structure. R. D. HEIDE REICH. *Phys. Rev.*, **77**, 271–83 (*Jan.* 5, 1950).

The dynamical or wave-mechanical theory electron diffraction is extended to include sever diffracted beams. Numerical intensity calculatio are presented which show that a strong (222) can accounted for by the theory. An impedance netwo model is briefly discussed which may aid in qualitati considerations of the dynamical theory for the case several diffracted waves.

GEOPHYSICS 55

550.34

4499. The earthquake of 28th August, 1946, and the depth of the earth's core. P. CALOI AND F. PERONACI. *Ann. Geofis.*, **2**, 493–502 (*Oct.*, 1949) *In Italian.*

An analysis of the travel-times of *ScS* waves from this deep earthquake, using Gutenberg and Richter's values for the velocity distribution, gives 2 920 km as the depth of the earth's central core. Good agreement was obtained between the results from various stations, whereas the use of Dahm's velocity distribution resulted in wide discrepancies.

E. M. FOURNIER D'ALBE

550.340

4500. On the measurement of the group velocity of siesmic surface waves. P. E. VALLE. *Ann. Geofis.*, **2**, 370–6 (*July*, 1949) *In Italian.*

The author examines the theory of the measurement of the group velocity of surface waves between two stations and points out the approximations underlying the methods commonly used.

E. M. FOURNIER D'ALBE

550.341

4501. Ground vibrations near explosions. B. F. HOWELL, JR. *Bull. Seism. Soc. Amer.*, **39**, 285–310 (*Oct.*, 1949).

H (hydrodynamic) and *C* (coupled) waves were observed in the experiments, which used electromagnetic induction seismometers with amplifiers and recording oscillograph (horizontal and vertical components). Measurements were made at 14 stations between 97 and 3 284 m from the shot-point *SE* of Los Angeles. The charges were exploded at depths of 6·7–12·5 m. The records disclose first compressional pulses P and P_3, then 3 body waves travelling along deeper paths, then the strong dispersed *C* pulse (largely longitudinal), then motio *T* on the transversal component, further *H* which is direct elliptical motion in a vertical plane, and final a Rayleigh-type motion *R*. The difficulties of possib theories for *C*, *H* and *R* are discussed. Explanatio of the *H* waves are suggested, based on the theory the Stoneley waves.

A. BEE

550.342 : 532.5

4502. On hydrodynamic earthquake effects. P. W WERNER AND K. J. SUNDQUIST. *Trans. Amer Geophys. Un.*, **30**, 636 (*Oct.*, 1949).

Deals with the hydrodynamic effect of horizont earthquake action. The theory is developed assumin harmonic motion, also taking the compressibility the water into consideration. The possibility resonance is discussed. Solutions are deduced for th most common types of hydraulic vessels. Th solutions contain expressions both for the dynam water pressure and for the displacements in the fluid The dynamic water pressure on the walls is calculate and the result presented in diagrams.

550.36

4503. Uranium on our planet. J. M. LOPEZ D AZCONA. *Bol. Radiactividad*, **22**, 175–88 (1949 Also *Rev. Geofis.*, **8**, 285–98 (*April–Sept.*, 1949) *Spanish.*

From present-day abundance of Pb isotopes, an known values of decay constants, the quantities of U and Th radioactive isotopes present on the eart $3{\cdot}5\times10^9$ yr ago are estimated. Under a number special assumptions, the conclusion is reached tha the heat developed by the decay of these nuclei ha been the main factor in determining the temperatur on the surface of the earth.

L. PINCHERL

550.37 : 537.591

4504. Cosmic radiation and the maintenance of a potential gradient in the atmosphere. S. A. KORFF. Letter in *Phys. Rev.*, **77**, 144 (*Jan.* 1, 1950).

The author points out that though a positive excess of cosmic ray particles arrives at the earth's surface the primary radiation must consist of both positive and negative particles, since otherwise the earth would rapidly acquire a charge sufficient to repel them. The superior penetrative power of the positive particles must cause a separation of charge and hence a potential gradient in the atmosphere, but the effect is not sufficiently powerful to produce the observed field. E. M. FOURNIER D'ALBE

550.371

4505. Observations of the electric field of the atmosphere during the eclipse of the sun on April 28th, 1949. J. ROUCH. *C.R. Acad. Sci., Paris*, **228**, 1547–9 (*May* 16, 1949) *In French.*

The earth's electric field during the eclipse of the sun was measured by means of a bifilar Wulf electrometer with radium collector. The variation of the electric field with time is plotted during 4 hr both on the day of the eclipse and on the following day. It is suggested that the electric field is greatly increased during the eclipse (from ~ 300 V/m to ~ 600 V/m on an average). R. H. GOLDE

550.38

4506. Natural remanent magnetism of igneous rocks and its mode of development. T. NAGATA. Letter in *Nature, Lond.*, **165**, 245–6 (*Feb.* 11, 1950).

550.38

4507. True magnitude of the geomagnetic secular variation. C. J. SWIFT AND W. M. ELSASSER. Letter in *Phys. Rev.*, **78**, 64 (*April* 1, 1950).

550.38 : 551.5 : 537.591 : 523.7

4508. "Relations between solar and terrestrial phenomena," Sixth Report, I.C.S.U. (1948) 216 *pp.*

Contains 40 short papers, of which some of the titles are listed below. Others are abstracted individually. A note on the spectrum of the great solar flare of 1946, July 25: M. A. Ellison (17–20). On the influence exerted by sunspots on solar radiation in the extreme u.v. and in the region of metric waves, as well as on the corpuscular radiation: K. O. Kiepenheuer (35–41). New aspects on solar and terrestrial relationships: M. Waldmeier (48–51). Progress of research on solar and terrestrial relations: C. G. Abbott (55–7). Solar influences on geomagnetism: J. Bartels (58–9). Solar chromospheric eruptions, cosmic radiation and terrestrial ionospheric phenomena: R. Bureau (60–4). Solar influences on the earth's magnetism and on the upper atmosphere: S. Chapman (65–8). Review of some contributions to solar and terrestrial magnetism: T. G. Cowling (69–70). Solar influences on geomagnetism and the upper atmosphere: V. C. A. Ferraro (71–3). Proposed research by the Dept. of Terrestrial Magnetism, Carnegie Institution of Washington: M. A. Tuve (74–7). Researches on the origin of magnetic storms: P. Bernard (101–2). Some observations of the H and K lines in the solar spectrum during a magnetic storm: H. A. Brück, F. Rutllant (103). Solar-geomagnetic relationships (Greenwich results): H. W. Newton (111–15). Summary of researches on the spectrum of the night sky: D. Barbier (157–8). Report on recent investigations dealing with solar and terrestrial relationships: L. Vegard (186–90).

550.384

4509. Geomagnetic indices, *K* and *C*, 1948. H. H. HOWE AND E. K. WEISMAN; J. BARTELS. *Association of Terrestrial Magnetism and Electricity* (*International Union of Geodesy and Geophysics*) *Washington, D.C. Bulletin* 12*b*. 120 *pp* (1949).

This volume completes the publication of the tables commenced in Bulletins 12 and 12a. In addition, it contains *K*-index material from the Potsdam–Seddin–Niemegk series beginning with 1900, and from the Lövo series beginning with 1936. Tables of the planetary index *Kp* and conversion tables for standardizing the indices are included. Reports will be issued quarterly in future, in the *J. Geophys. Res.*

550.384

4510. Sudden commencements in geomagnetism: their dependence on local time and geomagnetic longitude. V. C. A. FERRARO AND W. C. PARKINSON. Letter in *Nature, Lond.*, **165**, 243–4 (*Feb.* 11, 1950).

550.385 : 523.755

4511. Magnetic disturbances and solar corona. A. H. SHAPLEY. "*Relations between solar and terrestrial phenomena,*" *Sixth report, I.C.S.U.* (1948) 116–20.

Analysis of Climax (U.S.A.) coronal emission intensities at 5 302 Å, and geomagnetic character figures for 1942–45 indicates that magnetic disturbances are most likely to occur ~ 3 days after *E*-limb passage of regions of intense coronal emission. D. R. BARBER

550.837.3

4512. Application of electrical resistivity measurements to the location of coal seams at shallow depth. J. T. WHETTON AND J. O. MYERS. *Proc. Leeds Phil. Lit. Soc.*, **5**, 263–8 (*Dec.*, 1949).

550.837.3

4513. Distribution of potential in a two-layered medium due to an internal source and sink and the determination of the approximate average resistivity of the medium. L. GILCHRIST, N. ROSTOKER AND B. BERNHOLTZ. *Canad. J. Res. A*, **28**, 1–28 (*Jan.*, 1950).

A brief review is presented of simple forms of electrical layout which are used in resistivity investigations on the upper surface of a two-layered medium of which the crust of the earth is assumed to be an example. The associative formulae for resistivity are given. Formulae are developed for use in conjunction with experimental results obtained by the use of drill holes whereby the source and sink are embedded in a two-layered medium. A.

550.837.3

4514. Location and tracing of galena-fluorspar veins at shallow depths by earth resistivity measurements. J. T. WHETTON AND J. O. MYERS. *Proc. Leeds Phil. Lit. Soc.*, **5**, 161–73 (*Dec.*, 1948).

550.93 : 539.155.2

4515. Geophysical interpretation of the isotopic analysis of ordinary lead. J. M. Lopez De Azcona. *Rev. Real Acad. Cienc. Madrid*, **42**, 393–420 (1948) *In Spanish.*

Basing his analysis on Nier's data for the Pb isotope ratios for various ores, the author deduces the variation with time of the Pb/U and Pb/Th ratios in the earth's crust and mantle. He concludes that at the time of formation of the earth's crust these ratios were greater in the crust than the mantle, and that the formation of U occurred 1 200 million yr earlier. E. M. FOURNIER D'ALBE

551.1

4516. Internal constitution of the earth. R. I. B. Cooper. *Nature, Lond.*, **165**, 216–19 (*Feb.* 11, 1950).

Report on a discussion at the R.A.S. The earliest evidence on the internal constitution of the earth came from astronomical observations, which gave the earth a moment of inertia of $0{\cdot}334\ Ma^2$ and a mean rigidity similar to that of steel; but which yielded no information on the internal distribution of rigidity or density. The analysis of the travel-times of seismic waves has given an insight into the variation of density with depth and has revealed the existence of a non-rigid core of radius $0{\cdot}545\ a$, and of an inner core which is probably rigid. The meeting discussed the various theories put forward to explain these observations. That of Kuhn and Rittermann, based on a supposed increase of H content with depth, was criticized both on cosmogonical grounds and for their neglect of loss of H from the interior by convection. Dr. Ramsey described his theory, which attributes the internal discontinuities to phase changes under increasing pressure, analogous to the transition of solid H to a "metallic" state at about 10^6 atmos. The theory leads to correct values for the densities of the other planets, except in the case of Mars, and can also explain the anomalies in the velocity distributions found just outside the boundaries of the cores. It was pointed out that the conductivity of the "metallic" phase is likely to be of the same order as that of Fe, but that there is no explanation of why it should be liquid. E. M. FOURNIER D'ALBE

551.46

4517. Diffraction of water waves passing through a breakwater gap. F. L. Blue, Jr. and J. W. Johnson. *Trans. Amer. Geophys. Un.*, **30**, 705–18 (*Oct.*, 1949).

Theoretical and experimental study.

551.46

4518. Energy exchange between the oceans and the atmosphere. G. E. R. Deacon. *Nature, Lond.*, **165**, 173–4 (*Feb.* 4, 1950).

A report on a recent Geophysical Discussion at the Royal Astronomical Society. The energy exchanged between the oceans and the atmosphere is of two kinds: heat and kinetic energy. While the oceans gain most of their heat directly from the sun, the lower atmosphere gains it largely from the oceans and mostly as the latent heat of water vapour. The heat transferred from ocean to atmosphere can be calculated from normal ships' observations on the basis of a formula developed by Sverdrup, though there is some doubt as to the effect of roughness of the surface. Jacobs has shown that the areas of maximum heat transfer are also those where violer storms originate. The mechanical stress of winds o the ocean surface gives rise to currents which in tur affect the heat transfer to the atmosphere, but agai the effect of roughness on the relation between stre and wind speed does not seem to be fully establishe There is a particular need for further work on th diffusion processes occurring both immediately abov and below the sea surface. E. M. FOURNIER D'ALBE

551.46.01

4519. Measurement of ocean waves. R. G. Folsom *Trans. Amer. Geophys. Un.*, **30**, 691–704 (*Oct.*, 1949)

Laboratory and field investigations demonstrate tha theoretical pressure ratios for pressure wave recorde are correct to within 10 to 20%. The theoretical corrected measured wave heights in shallow wate are low. The University of California Mark III an Mark V wave recorders are described and typica records from the latter are reproduced. The limita tions of the available information on spar buo damping disc systems for deep water wave measure ments are summarized. A

ATMOSPHERE . METEOROLOGY 551.5

551.5

4520. Solution of the telegrapher's equation wit boundary conditions on only one characteristic G. E. Forsythe. *J. Res. Nat. Bur. Stand., Wash.*, **44**, 89–102 (*Jan.*, 1950).

Forecasting a certain idealized horizontal, auto barotropic, non-viscous, non-diverging atmospheri flow considered by Rossby leads to an unusua boundary-value problem for the telegrapher's equa tion, involving boundary values on only one charac teristic. It is shown how to find unique solution periodic in the longitude; these are represented i terms of a Green's function. A procedure for com puting the Green's function is set down and is show to be optimal in a restricted sense. The Green' function is tabulated for 72 longitudes and 14 time values. An alternative solution by a differenc equation is mentioned. A

551.510.3 : 523.5

Atmospheric density profile and gradients from earl parts of photographic meteor trails. *See Abstr.* 3700

551.510.4

4521. Chemical composition of the stratosphere a 70 Km height. K. F. Chackett, F. A. Paneth and E. J. Wilson. *Nature, Lond.*, **164**, 128–9 (*July* 23 1949).

Samples of air obtained by balloons have show that up to 20 km the composition of the atmosphere is the same as at ground level. Above this heigh the He content appears slightly greater, the O conten slightly smaller. To test whether this indicated a diffusive separation it was felt that observations from greater heights were needed. This has been accom plished recently by means of V.2 rockets. The methods of obtaining and analysing the samples are described. Analyses show no detectable difference for A and Ne at a height of 70 km from the values

at ground level. He indicates a deficit of 4%. Further research is desirable as the samples may have been contaminated by ground air. The absence of O and H is accounted for. A. E. M. GEDDES

551.510.4

4522. The distribution of atomic and molecular oxygen in the upper atmosphere. R. PENNDORF. Letter in *Phys. Rev.*, **77**, 561–2 (*Feb.* 15, 1950).

551.510.4

4523. Nitrous oxide as a constituent of the atmosphere. R. L. SLOBOD AND M. E. KROGH. *J. Amer. Chem. Soc.*, **72**, 1175–7 (*March*, 1950).

N_2O has been found present to the extent of $0{\cdot}00005 \pm 0{\cdot}00001\%$ by vol. It was separated from the air by condensation under reduced pressure at approximately −195°C. The gas was purified in a high vacuum system, and was qualitatively and quantitatively determined using the mass spectrometer. A.

551.510.535

4524. Relations between ionospheric *D* region and chromospheric eruptions. A. AND E. VASSY. "*Relations between solar and terrestrial phenomena*," *Sixth Report, I.C.S.U.*, 90–3 (1948) *In French.*

It is known that sudden chromospheric eruptions—"flares"—produce greatly increased ionization in region *D*, altitude 70–80 km. Various theories of the mechanism of this phenomenon have been proposed, and discounted on account of the very high absorption of the atmospheric gases above 80 km for the far u.v. $\sim 1\,000$ Å. It is here suggested that the ionized element is atmospheric Na, of which there are known to be 10^{10} atoms per cm² vertical column of atmosphere between 70 km and 110 km, with maximum concentration at 80 km. The exciting radiation can be u.v. light, or near 2 412 Å, corresponding to the ionization potential of Na. D. R. BARBER

551.510.535

4525. Electron diffusion in the ionosphere. R. SEELIGER. *Ann. Phys., Lpz.* (*Folge* 6) **3**, 297–304 (1948) *In German.*

A theoretical paper on the role that electron diffusion plays in the formation of the ionospheric layers. It is shown that the lack of sufficient reliable quantitative data makes it difficult to formulate valid conclusions on the importance of this phenomenon. W. J. G. BEYNON

551.510.535

4526. The height of the F_2 layer and sunspot numbers. R. EYFRIG. *Rev. Sci., Paris*, **86**, 673–4 (*Nov.*, 1948) *In French.*

The well-known correlation between the height of the F_2 layer and sunspot numbers is illustrated in the form of graphs for data from Huancayo. Correlation coefficients for each month at midday and midnight are given. W. J. G. BEYNON

551.510.535

4527. Prediction of ionospheric conditions for antipodal stations. G. R. WHITE AND R. F. POTTER. *Trans. Amer. Geophys. Un.*, **30**, 686–90 (*Oct.*, 1949).

Predicted values of F_2 critical frequencies for all hours of the day for Watheroo, Western Australia, and for Baton Rouge, Louisiana, were compared with observed values. It was found that predicted values for Baton Rouge, based on data from Watheroo, agreed with observed values almost as well as those predicted from Baton Rouge values. The two stations in question are located at almost antipodal points. Similar tests conducted for other stations in corresponding geographical latitudes, north or south, but not antipodally located showed poorer agreement. It is concluded from this that data observed at any given station may be applied with considerable assurance to antipodal points for which no data are available. A.

551.510.535

4528. Tidal effects in the ionospheric *F*-layer. M. W. JONES AND J. G. JONES. *J. Met.*, **7**, 14–20 (*Feb.*, 1950).

Measurements of the semi-thickness of the *F*-layer in Alaska reveal solar and lunar diurnal and semi-diurnal variations, the amplitudes and phase angles of which are given.

551.510.535

4529. The problem of the diurnal variation of the electron density of the F_2 layer at equatorial stations. R. EYFRIG. *Naturwissenschaften*, **37** (*No.* 3) 67–8 (*Feb.*, 1950) *In German.*

The equinoctial diurnal variations in F_2-layer critical frequencies for 3 equatorial stations (Huancayo, Bandoeng and Palau) are briefly considered. It is suggested that the flattening of the diurnal curves over the mid-day periods (observed at Huancayo and Palau) may be ascribed to geomagnetic influences and furthermore that the characteristic summer diurnal variations for higher latitude stations may also be attributed to such causes. W. J. G. BEYNON

551.510.535

4530. A correlation between ionospheric phenomena and surface pressure. M. W. JONES AND J. G. JONES. Letter in *Phys. Rev.*, **77**, 844 (*March* 15, 1950).

551.510.535

4531. On the incidence and structure of the E_2 layer of the ionosphere. W. BECKER AND W. DIEMINGER. *Naturwissenschaften*, **37** (*No.* 4) 90–1 (*Feb.*, 1950) *In German.*

Typical data are given which emphasize the frequent occurrence and importance of the E_2 layer. The small thickness of the layer and the marked solar control of its electron density are taken to indicate that a solar neutral corpuscular stream may be the ionizing agent. W. J. G. BEYNON

551.510.535

4532. Cellular atmospheric waves in the ionosphere and troposphere. D. F. MARTYN. *Proc. Roy. Soc. A*, **201**, 216–34 (*March* 22, 1950).

Consideration of horizontally travelling disturbances of electron densities in the F_2 region of the ionosphere suggests that they are identical with the supposed vertically travelling disturbances discovered by Wells, Watts and George [Abstr. 2412 (1946)]. They appear to be due to horizontally travelling atmospheric cellular waves of the type first investigated by Lamb. The theory of such waves is developed to include wind with linear vertical shear, special attention being paid to the conditions of bounding by temperature gradients. It is found that

such waves appear to be the cause of the microbarometric oscillations long known in the troposphere. The theory of these is worked out in some detail. In the ionosphere, the earth's magnetic field profoundly affects the observed motions of ionization in the F_2 region, leading to a height gradient in the phase of these oscillatory motions. This gradient makes horizontally travelling disturbances appear to have a vertical component of motion, thus simulating vertically moving electron clouds. The bounding conditions for these cells in the F_2 region appear to necessitate a value for γ, the ratio of specific heats of air, $\leqslant 1{\cdot}4$. A.

551.510.535 : 621.396.11

4533. Absorption processes in the ionosphere. B. Beckmann. *Arch. elekt. Übertragung*, **2**, 124–35 (*April–May*, 1948) *In German.*

A theoretical analysis of the problem, combined with short-wave radio field-strength measurements over a transmission path of 1 000 km, leads to the following conclusions: (1) during the day period, deviation absorption and *D*-layer absorption both occur, but the former predominates after sunset; (2) assuming a parabolic ionization gradient with height, deviation absorption varies linearly with frequency; (3) studies of day-to-day variations suggest that *D*-region absorption varies with solar wave radiation and deviation absorption with solar corpuscular radiation; (4) the seasonal variations of the two types of absorption are in opposite senses; (5) only 25% of the many field-strength measurements show a sharp critical frequency cut-off at sunset—in the remaining cases the field strength gradually diminished below the noise level of the receiver.

W. G. J. BEYNON (R)

551.510.535 : 621.396.11

4534. Ionospheric research during the period, 1939–1946. H. W. Wells. "*Relations between solar and terrestrial phenomena*," *Sixth report, I.C.S.U.* (1948) 78–80.

By means of "panoramic" long frequency-range pulse recorders it is now possible to observe continuously the characteristics of the entire ionosphere. Motion-picture film recording with this apparatus has revealed hitherto unsuspected fluctuations, including "cloud" movements associated with ionospheric-geomagnetic storms. Two other direct connections have been noted, (i) magnetic bays observed in polar latitudes coincide with excessive ionospheric absorption; (ii) simultaneous ionospheric and auroral observations show that sporadic *E*-region ionization occurs when an aurora is overhead.

D. R. BARBER

551.510.535 : 621.396.11

4535. Ionospheric sounding experiments in Germany. W. Dieminger. *Research, Lond.*, **2**, 571–6 (*Dec.*, 1949).

The principles are given of ionospheric equipment developed in recent years in Germany for normal and oblique incidence work. Experimental observations made with the new equipments are considered.

W. J. G. BEYNON

551.510.535 : 621.396.11

4536. World morphology of ionospheric storms. E. V. Appleton and W. R. Piggott. *Nature, Lond.* **165**, 130–1 (*Jan.* 28, 1950).

The manifestation of an ionospheric storm varies with latitude. At high latitude stations geomagnetic disturbances are accompanied by a negative ionospheric phase (i.e. a decrease in F_2-layer critical frequency). At temperate latitudes the ionospheric storm often exhibits a positive-negative phase sequence and at equatorial stations only a positive phase is observed. The ionospheric changes associated with sudden commencement geomagnetic disturbances and the influence of ionospheric storms on F_2-layer variability are also briefly discussed. W. J. G. BEYNON

551.55

4537. Characteristics of barometric waves. Vercelli. *Comment. Pont. Acad. Sci.*, **9** (*No.* 1–32 (1945) *In Italian.*

After a historical introduction to the subject, the author presents results from the harmonic analysis of barometric records from many European stations. These reveal the existence of various periodic fluctuations, including those with periods of 36, 22, 16 and 11 d. The author discusses the geographical distributions of phase and amplitude, which indicate that some of the oscillations are of quasi-stationary character. E. M. FOURNIER D'ALB

551.55

4538. On energy dispersion in the atmosphere. T.-C. Yeh. *J. Met.*, **6**, 1–16 (*Feb.*, 1949).

Propagation of energy through dispersive waves is investigated in 4 atmospheric models. The waves are characterized by an approximate geostrophic balance. For each model diagrams show the relation between group velocity, wave velocity and wavelength. R. S. REA

551.51

4539. A preliminary report on experiments with thermally produced lateral mixing in a rotating hemispherical shell of liquid. D. Fultz. *J. Met.*, **6**, 17–3 (*Feb.*, 1949).

Theoretical ideas concerning the influence of lateral mixing on the relative circulations in thin rotating spherical shells of liquid are outlined. Experiments made to test these ideas are described and illustrated by photographs. For a hemispherical shell heated from below at the pole it is found that systematic relative zonal circulations develop when the shell is rotating, but not when it is stationary. Averages of the relative circulations show a well defined zone of easterly motion from the equator to about latitude 30° and a zone of predominantly westerly motion from 30° towards higher latitudes. The average speeds, when expressed nondimensionally, have the same order of magnitude as average zonal speeds, similarly expressed, in the free atmosphere of the earth. R. S. REA

551.51

4540. The effect of viscosity on circulation. C. Truesdell. *J. Met.*, **6**, 61–2 (*Feb.*, 1949).

It is shown mathematically that the mechanism by which circulation is changed in a viscous compressible fluid of constant viscosity can follow from the mechanisms for inviscid fluids and modify them by the addition of an effective extraneous force and a

ffective pressure. In a uniform irrotational flow of a omogeneous incompressible fluid, vorticity is not reated even by a variation of viscosity. The rate of hange of circulation apparent to an observer on the arth is equal to that apparent to a fixed observer, inus twice the earth's angular speed times the rate f change of the projection of the circuit upon the arth's equatorial plane. R. S. READ

551.547 : 523.58

4541. Meteoric exploration of the upper atmosphere. F. LINK. "*Relations between solar and terrestrial phenomena*," *Sixth report, I.C.S.U.* (1948) 171–3. *In French.*

By applying Öpik's theory to a statistical analysis f the times of apparition, or disappearance of 881 eteors of known geocentric orbits, it is found that ie atmospheric density gradient within the height nterval, 80 to 120 km is less steep in winter than in ummer. D. R. BARBER

551.52

4542. Diurnal variation of the mean temperature of zone in the atmosphere. E. VASSY. *C.R. Acad. ci., Paris*, **228**, 764–5 (*Feb.* 28, 1949) *In French.*

551.521

4543. The measurement of solar plus sky ultra- olet radiation. E. R. COOPER. *N.Z. J. Tech. Sci.*,) (*No.* 3) 181–7 (1948).

551.521

4544. Notes on the measurement and estimation of mospheric radiation. 2. G. D. ROBINSON. *Quart. Roy. Met. Soc.*, **76**, 37–51 (*Jan.*, 1950).

An account is given of further measurements of mospheric radiation which confirm former con- usions regarding the errors of two types of radiation hart when used to compute total radiation at the rface [*ibid.*, **73**, 127 (1947)]. A.

551.521.1

4545. Investigations carried through at the Station Forest Meteorology at Os. I. On radiation, sun- ine and cloudiness. H. S. PAULSEN. *Bergens Museums Arb.* (*No.* 2) 1–44 (1950).

During the summers of 1944 and 1945 measure- ents were made at Os of the duration of sunshine, e total global radiation as recorded by a Robitzch inograph and also instantaneous values of the obal radiation, using a Moll–Gorczynski solarimeter. .v. radiation was also measured in 1945 with a u.v. osimeter. Relations are obtained between global diation and the sun's altitude, the duration of sun- ine and the mean cloudiness. Instantaneous easurements show that with the sun shining the ect of partial low cloud cover is to increase the obal radiation. A relation is also given between e incoming radiation and cloudiness with the sun bscured. Measurements with the u.v. dosimeter dicate that the diffuse u.v. radiation from a clear y is always > the direct radiation from the sun; e effect of clouds is in this case to decrease the coming radiation. E. M. FOURNIER D'ALBE

551.524

4546. Variation of the diurnal sums of heat of the attered radiation of the atmosphere. N. N. KALITIN. *okl. Akad. Nauk, SSSR*, **67** (*No.* 5) 827–9 (1950) *Russian.*

551.524

4547. Air temperature modification by vertical transport. R. G. FLEAGLE. *J. Appl. Phys.*, **21**, 326–8 (*April*, 1950).

It is suggested that when the air temperature increases upward an efficient and economical method for modifying low temperatures near the ground is to force air downward through vertical stacks from the relatively warm air aloft. The necessary power per unit mass is mainly a function of the air velocity in the stack. The energy required is compared with the energy required to heat the air originally near the ground; under a strong temperature inversion it is considerably less. A.

551.55

4548. ? A fundamental property of atmospheric circulation. A. H. R. GOLDIE. Letter in *Nature, Lond.*, **165**, 481–2 (*March* 25, 1950).

551.578.1 : 532.65

4549. The size distribution of raindrops. A. C. BEST. *Quart. J. Roy. Met. Soc.*, **76**, 16–36 (*Jan.*, 1950).

Experimental data relating to drop size distribution in rain are examined and it is shown that in many cases the size distribution is in accordance with the following formulae: $1 - F = \exp[-(x/a^n)]$; $a = AI^p$; $W = CI^r$; where F = fraction of liquid water in the air comprised by drops with dia. $< x$; I = rate of precipitation; W = amount of liquid water per unit volume of air. A, C, p, r and n are constants. If x is measured in mm, I in mm/hr and W in mm^3/m^3 the mean values of A, C, p, r and n are 1·30, 67, 0·232, 0·846 and 2·25 respectively. There may be appreciable variations from these mean values, particularly in the case of n, if the precipitation is essentially of a showery or orographic nature. Tables based on these formulae are given showing values of W and of the number and total volume of drops between certain diameter limits for various rates of rainfall. A.

551.58

4550. Long-period fluctuations of the general circulation of the atmosphere. H. C. WILLETT. *J. Met.*, **6**, 34–50 (*Feb.*, 1949).

Facts of observation concerning the nature of climatic variations on the earth's surface during observational time, postglacial or historical time, and the geological past are summarized with particular emphasis on possible interpretations or explanations of the changes. Variations in the solar constant are favoured. R. S. READ

551.593.5

4551. On the atmospheric shadow of the earth. V. G. FESSENKOFF. *Astr. J. USSR*, **26** (*No.* 4) 233 (1949). English Abstr. in *Astr. News Lett.* [*Harvard*] (*No.* 47) *In Russian.*

A review of the author's observations of the "earth's shadow" caused by the peculiar properties of the atmospheric intensity field with nearly horizontal incidence of solar radiation is followed by a résumé of his previously-published theoretical treatment [*Publ. Astrophys. Obs.* (*Moscow*) **2** (1923)] which is extended to give isophotal curves for the diffuse radiation emitted by a representative point in terms of the density of the air, the height of the reduced

atmosphere, and the atmospheric extinction properties. The total observed brightness in any given direction is determined by integration along the line of sight, allowing for extinction, the surface brightnesses in the plane of the sun and observer being shown by tables and diagrams for solar altitudes $-1°$ to $-5°$, and directions of observation with zenith distances $69\frac{1}{2}°$ to 90°. An observed systematic difference between morning and evening is attributed to different atmospheric conditions, higher-order scattering having a pronounced influence, and it is concluded that such observations are greatly superior to the direct measurement of solar radiation for determining higher-order scattering in certain directions and the constancy of the optical properties of the atmosphere. M. W. OVENDEN

551.593.5 : 535.343.4

4552. The transmission of the atmosphere near ground level in u.v. and visual spectral regions. B. KOCH. *Optik*, **5**, 258–73 (*July*, 1949) *In German.*

By means of photoelectric filter photometry in 8 spectral regions from near i.r. to far u.v. atmospheric transmission coefficients have been obtained at each mean wavelength over distances up to 7·5 km. The results have been applied to an experimental test of Koschmieder's visibility equation for u.v. and green rays. D. R. BARBER

551.593.7

4553. On the polarization of sky light. A. CARRELLI. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **1**, 493–500 (*May*); 907–16 (*Sept.*); 1012–17 (*Oct.*); 1242–51 (*Dec.*, 1946) *In Italian.*

The theory of Soret–Hurion is developed and improved, taking into account the depolarizing effect of light scattered by particles of dust. Measurements with Savart and photoelectric polariscopes show good agreement with the new theory. G. RIGHINI

551.593.9

4554. The height of emission layers in the upper atmosphere. F. E. ROACH AND D. BARBIER. *Trans. Amer. Geophys. Un.*, **31**, 7–12 (*Feb.*, 1950).

The brightness of the night sky in the Mojave Desert has been systematically measured with a recording photoelectric photometer of recent design. The instrument automatically covers the entire sky in a series of horizon-to-horizon sweeps in 8 different azimuths. Observations are alternately made through two interference filters one of which includes a characteristic emission of the upper atmosphere and the other excludes the emission and serves as a control. In the interpretation of the data in terms of the heights to the emitting layers an attempt has been made to allow for the asymmetrical brightness of the night sky for various azimuths. For four nights in the winter of 1948–1949 a height to the emitting layer of 110 km was found for O I 5577, and for three nights during the same period a height of 310 km for Na I 5893. A.

551.593.9

4555. Sodium in the upper atmosphere. D. BARBIER AND F. E. ROACH. *Trans. Amer. Geophys. Un.*, **31**, 13–17 (*Feb.*, 1950).

Observations of the emission of the Na *D* lines in the late twilight are interpreted on the assumption that the physical cause of the radiation is resonan excitation of the Na atoms by sunlight. The distrib tion of neutral Na atoms in the region 200 to 600 k is found to follow the law $n = 1{\cdot}4\ e^{-h/250}$ atoms/c where h is the height above the earth's surface in k The apparent scale height of 250 km is $\gg$ that of t lower atmosphere (about 10 km), suggesting eith that the upper atmosphere decreases in density mu more slowly than the lower atmosphere or that Na of extra-terrestrial origin.

551.5

4556. The annual variation of the gradient of potential of atmospheric electricity. N. A. PARAMONO *Dokl. Akad. Nauk, SSSR*, **71** (*No.* 1) 39–40 (19 *In Russian.*

551.59

4557. The study of atmospherics and terrestr electric changes at Cambridge. I. An electromechani recorder of potential gradient. M. BALLEST CRUELLAS. *An. Real Soc. Esp. Fis. y Quim.*, **44** 511–22 (*Sept.–Oct.*, 1948) *In Spanish.*

Records of potential gradient during disturb weather were obtained by the raised sphere metho using a capillary electrometer. Apart from sudd changes due to lightning flashes, there were also ra variations (of the order of 500 V/m in 15 sec), wh could not be explained in terms of the horizontal di of bipolar clouds. They were more probably due rapid separation of charges within clouds. To expla certain features in the records of potential gradie and air-earth current it is suggested that the cha distribution in clouds may be more complex than generally assumed. E. M. FOURNIER D'AL

551.59

4558. The infrared spectrum of lightning. P. JOSE. *J. Geophys. Res.*, **55**, 39–41 (*March*, 1950).

The spectrum of lightning has been observed in t infrared up to $\lambda 8800$, and is found to be due exclusive to O I and N I.

551.59

4559. Experiments on the Aurorae. K. MALMFORS. "*Relations between solar and terrestr phenomena, Sixth report,*" *I.C.S.U.* (1948) 108–10.

Observations of the electrical discharge in t vicinity of a magnetized steel sphere, suspended an evacuated chamber at pressures, 10^{-3} 10^{-4}mm Hg, and voltages, 500 to 8 000 V, show th the discharge channels are delineated by electro originating between sphere and negative electro and that these electrons produce a drift motion d to inhomogeneity of the magnetic field. Experimen results support Alfven's theory of magnetic storm and aurorae [Abstr. 3701 (1950)]. D. R. BARB

551.59

4560. Aurora spectra showing broad hydrogen lin C. W. GARTLEIN. *Trans. Amer. Geophys. Un.*, 3 18–20 (*Feb.*, 1950).

The best spectra of the aurora taken since 19 with the two-prism spectrograph having camera le 10 cm focal length and $F/1{\cdot}65$ aperture show lin approximately 5 Å broad, within 2 to 5 Å of t positions of H_α, H_β and H_γ. Large-scale micr photometer tracings separate these lines from t

arious bands of N, and the identification as H seems stablished. Many spectra taken on the time-equence spectrograph, aperture $F/0{\cdot}8$, show that nese lines appear most strongly preceding and during n outburst of aurora. This is in support of Eckersley's neory of ionosphere disturbances. Thus, there is vidence to indicate that the H is of solar origin and primary cause of some aurora outbursts and agnetic storms. A.

551.594.5

4561. Strong permitted O I and N I lines in the nfrared auroral spectrum. A. B. MEINEL. *Trans. mer. Geophys. Un.*, **31**, 21–4 (*Feb.*, 1950).

Observations of the near i.r. spectrum of the urora show the presence of strong permitted lines f O and N and enhancement of the first positive N ands. The newly observed atomic lines provide nformation about the relative numbers of O and N toms and the variation of excitation with energy evel. Concurrent observations of the night-sky pectrum show conclusively that the telluric bands appear in absorption. Emission is observed, however, from the subordinate bands of the atmospheric O band. A.

551.594.5

4562. The near infra-red spectrum of the polar aurora. W. PETRIE. Letter in *Phys. Rev.*, **77**, 719 (*March* 1,1950).

551.594.51

4563. On the mechanism of the emission of the auroral green light in the night sky. M. MIYANISHI. *J. Phys. Soc. Japan*, **5**, 1–4 (*Jan.–Feb.*, 1950).

A theory is proposed to account for the well-known 5 577 Å emission from the night sky by supposing that, at the level of emission, the concentration of neutral O atoms is diluted by a large excess of H atoms. Excitation is produced by collision with 2 H atoms, a mol of neutral H resulting. The excited O atom then undergoes the forbidden transition, $^1S_0 \rightarrow {}^1D_2$, under the influence of the molecular field of the uncombined H mol, with emission of the green line at 5 577 Å. D. R. BARBER

BIOLOGY 57/59

578 : 534.321.9

4564. Ultrasonic tissue disintegrator. F. F. BIRD ND K. S. LION. *Rev. Sci. Instrum.*, **21**, 189–90 *Feb.*, 1950).

578 : 539.163

4565. Methods of biological research with the aid f radioactive isotopes. G. JOYET. *R.C. Ist Super. anità*, **12** (*No.* 7–8–9) 608–36 (1949) *In French.*

Specimens were ashed in a silica crucible at 50–700°C and were measured by a G–M counter aintained in a thermostat at ± 0.2°C. Isotopes tudied are P^{32}, K^{42}, Fe^{59} and Na^{24}. The selec-vity S is defined as the ratio of the activity per g f tissue retained, compared to the mean activity jected per g of animal. The possibility is discussed f accumulating in a stable form elements of large apture cross-section in a tumour in order to institute differential therapy for slow neutrons.

T. A. CHALMERS

578 : 539.163

4566. Account of the history of the biological pplication of indicators. G. HEVESY. *R.C. Ist uper. Sanità*, **12** (*No.* 7–8–9) 637–92 (1949) *In French.*

A 25-yr survey including a bibliography of 436 ferences. T. A. CHALMERS

MEDICAL SCIENCE
HUMAN PHYSIOLOGY 61

612.84 : 535.83

4567. On the twilight performance of telescopes. LÖHLE. *Optik*, **5**, 287–308 (*Aug.*, 1949) *In German.*

Discusses the expression given by Kühl [Abstr. 1085 937)] for performance, defined as resolution of the telescope relative to that of the unaided eye under similar conditions; it is $\propto$ the magnification and to the fourth root of the light intensity; it follows that an increase of magnification is 4 times as effective as a similar increase in area of eye pupil, and for a given diameter of objective a decrease in transmission can be compensated by an increase of magnification only $\frac{1}{2}$ as great—the changes being expressed fractionally. The effective eye pupil under twilight conditions for observers of different ages is discussed. Measurements of the resolution of the eye by Nagel [*Z. Instrumkde*, **60**, 279 (1940)] show a discrepancy with calculations; the bearing of the Stiles–Crawford effect on this is discussed. Other equations for telescope performance are briefly discussed [see Nagel and Klughardt, Abstr. 3517 (1936)]. It is considered that the various equations are reliable only with the test objects actually used, the various standard objects being described. 85 references are given. G. F. LOTHIAN

612.84

4568. Sensitivity of the eye to the time-variation of brightness. A. V. LUIZOV. *Dokl. Akad. Nauk, SSSR*, **70** (*No.* 5) 829–31 (1950) *In Russian.*

612.84

4569. Variation of visual acuity with various test-object orientations and viewing conditions. G. C. HIGGINS AND K. STULTZ. *J. Opt. Soc. Amer.*, **40**, 135–7 (*March*, 1950).

Visual acuity was measured in terms of the reciprocal of the angle in minutes subtended by the individual lines in a parallel-line test object at the limit of perception of the lines when the observer was allowed to see the target for < 1 msec. Visual acuity, measured with the lines passing either vertically or horizontally through the visual field, was found to be approximately 20% higher than when measured with

the lines passing diagonally through the visual field at angles of 45 and 135 degrees with the horizontal. These results indicate that the variation in the visibility of a parallel-line test object as a function of its orientation is not produced by preferential directions for eye movements. The variation of visual acuity with test-object orientation was also measured as a function of pupil diameter and fixation point, but these data do not give any conclusive evidence as to the factors producing the variations. A.

612.85

4570. The time in which equilibrium state of auditions is established. I. The damping constant of the inner ear. II. The time constant of building up or decay of auditory sensation at the threshold. Y. MAKITA AND S. MIYATANI. *J. Phys. Soc. Japan*, **5**, 43–8 (*Jan.–Feb.*, 1950).

614.8

4571. Protective materials for field definition in radiation therapy. E. D. TROUT AND R. M. GAGER. *Amer. J. Roentgenol. Radium Ther.*, **63**, 396–408 (*March*, 1950).

Transmission data were taken for lead, brass, steel, lead rubber, lead glass and plate glass over a range of 60 to 2 000 kV peak at various filtrations. The data have been plotted in the form of graphs for all the conditions studied. Tables have been prepared, showing the thickness of the various protective materials for transmission of 10, 5, 1, 0·5 and 0·1%. A.

614.8

4572. Some measurements of gamma-ray doses received by a radiotherapist during radium operations. J. L. HOWARTH, H. MILLER AND J. WALTER. *Brit. J. Radiol.*, **23**, 245–55 (*April*, 1950).

614.8 : 539.16

4573. Disposal of radioactive wastes by biological methods. II. C. C. RUCHHOFT. *Atomics*, **1**, 52–5 (*Sept.*, 1949).

See Abstr. 636 (1950). From the measured uptake of Pu by zoogloeal sludge, it is estimated that an extraction plant accepting 10 000 gallons of waste water per day, with a Pu concentration of 1 μg per litre, could remove 99% of the Pu and require 1 disposal of only $\sim$ 2 500 lb radioactive sludge ca per month. A sketch layout of such a plant, w 2 stages of extraction, is discussed. The cost extraction need not be $>$ 10 times that of domes sewage treatment. The possible need to remo certain radicals and ions present in radioactive was because of their toxicity to zoogloeal flocs, is brie considered. A. P. FREN

614.8 : 539.1

4574. Calculations for maximum permissible e posure to thermal neutrons. W. S. SNYDE *Nucleonics*, **6**, 46–50 (*Feb.*, 1950).

615.8

4575. The integral dose received from a uniform distributed radioactive isotope. F. BUSH. *Brit. Radiol.*, **22**, 96–105 (*Feb.*, 1949).

Using simple geometrical relationships, the integ γ-ray dose is calculated for a number of regul bodies, including cylinders, spheres and cuboid and, taking account of elongation, a general relati is deduced between dose and volume. The analy is extended to determine the dose in a figure appro mating to the human body, and the results a tabulated for a range of heights and weights patient. The effect of change in absorption coefficie of γ-rays is examined, and a calculation is also giv of the loss of β-ray energy through the skin in treatment in which a β-emitter provides the whole part of the irradiation. F. T. FARM

615.8

4576. Depth dose of electrons from the betatr L. S. SKAGGS. *Radiology*, **53**, 868–74 (*Dec.*, 1949).

The electron beam from a 17 MeV betatron collimated by a Pressdwood channel and directed in water, and "doses" are measured with a polystyre walled chamber. At 150 cm, dose rates are equivale to about 30 r/min. Depth-dose curves show a ri of 5 to 10% in the first 4 cm, then a rapid fall-o in the range 5 to 7 cm; beyond this there is 1–2% d to X-rays. Iso-dose curves for an 11 cm beam a given and show almost flat contours within t main beam. F. T. FARM

TECHNICAL MATERIALS 66/67

666.1 : 539.11 : 536.7

4577. What is a glass? G. O. JONES AND F. E. SIMON. *Endeavour*, **8**, 175–81 (*Oct.*, 1949).

Glass is a non-thermodynamic phase, since its properties and condition are not completely defined, from the standpoint of formal thermodynamics, t any of the terms "solid," "liquid" or "supercool liquid." The implications of this are discussed i non-mathematical terms. (22 refs.)

PHOTOGRAPHY 77

771

4578. Photographic progress in 1949. G. E. MATTHEWS. *Photogr. J., A* (*Spec. No.*) 109–25 (*April*, 1950).

771.4 : 535.89

Light output from a spark "point source." *See Abstr.* 4009

771.5

4579. "Developable" and developed silver halide grains. Attempt at a theory of development of grains made "developable" by a given exposure. Integration of the simple formulas over all grain sizes for the case of an exponential size-frequency function. L. SILBERSTEIN. *J. Franklin Inst.*, **249**, 207–22 (*March*, 1950).

771.53

4580. On the relation between the characteristic curve and the resolving power of a photographic emulsion. A. FIORENTINI. *Atti Fond. "Giorgio Ronchi,"* **5**, 17–24 (*Feb.*, 1950) *In Italian.*

771.53

4581. Photographic materials for use in the ultraviolet. R. D. B. FRASER. *J. Sci. Instrum.*, **27**, 106–7 (*April*, 1950).

The speeds and contrasts of photographic plates in the ultraviolet are well known. Information on cinematograph films, which are more convenient for photomicrography, is not generally available. The measurement of speed contrast and graininess in the region 2 650 Å is described and results given for 10 cinematograph films. The number of photographs which may be obtained for a given radiation dosage is an important characteristic of an emulsion in the ultraviolet photomicrography of living cells. An index which is useful as a guide to this quantity is derived. A.

771.534.5 : 535.341

4582. An improved photomultiplier tube color densitometer. M. H. SWEET. *J. Soc. Mot. Pict. Engrs*, **54**, 35–62 (*Jan.*, 1950).

Description of a densitometer capable of using sharp-cutting filters to measure colour densities up to 4·0 and over. A.

778.3

4583. (*a*) On grain spacing along the traces of ionizing particles in photographic plates. (*b*) Test of a new formula for the spacing of grains along the traces of ionizing particles in photographic plates. G. LOVERA. (*a*) *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*), **2**, 51–4 (*Jan.*, 1947); (*b*) *Nuovo Cim.* (*Ser.* 9) **3**, 20–7 (1947) *In Italian.*

The formula of Wilkins and Helens is improved by taking into account the definite size of the grains and the fact that the impulse supplied to an electron is dependent on the radius of action of the ionizing particle. G. RIGHINI

778.3

4584. Underwater photography. J. B. COLLINS. *Photogr. J., B*, **90**, 24–31 (*Jan.–Feb.*, 1950).

The requirements for underwater photography are discussed, and many of the applications indicated. Existing information on previous work and the properties of the medium are discussed. Measurements of water transparency, and experimental work to relate photographic results to this and other conditions, are described. The design of underwater kine cameras and lighting equipment are described in some detail, together with the development of a technique of "free" compressed air diving technique, which permits photography under water as easily as in air. The possibilities of high-speed photography and future developments are also considered. A film has been made to illustrate the results obtained and some of the applications of the technique so far developed. A.

778.3

4585. Detection of tracks and stars in nuclear track plates. E. H. LAND, G. BIRD AND W. A. SHURCLIFF. *J. Opt. Soc. Amer.*, **40**, 61–3 (*Feb.*, 1950).

A rotating-azimuth, planar, dark-field, illumination scheme has been developed which provides sufficient contrast so that low magnification (50 to 100 times) may be used. The field of view is thereby increased to 2–4 mm and the depth of field becomes comparable to the total thickness of the emulsion. A.

778.3 : 535.33

Photographing spectra in the vacuum ultraviolet. *See Abstr.* 3918

778.3 : 537.133

4586. Range-energy relation for protons in nuclear emulsions. H. BRADNER, F. M. SMITH, W. H. BARKAS AND A. S. BISHOP. *Phys. Rev.*, **77**, 462–7 (*Feb.* 13, 1950).

An experimental range-energy relation in Ilford *C*-2 emulsion has been obtained for protons up to 39·5 MeV. In the region from 17 to 33 MeV the relation for dry emulsion is fitted by the empirical equation $E_{(\mathrm{MeV})} = 0{\cdot}251R_{(\mu)}^{0{\cdot}581}$. Variations in water content due to changes in atmospheric humidity make several % difference in range. The range in Ilford glass is found to be $18 \pm 4\% >$ in dry *C*-2 emulsion. A.

778.33

4587. An improved X-ray phototimer. P. C. HODGES, R. T. JENKINS AND S. F. WILLIAMS. *Radiology*, **54**, 64–73 (*Jan.*, 1950).

778.33

4588. Speed and contrast in radiography. H. S. TASKER. *Photogr. J., B*, **90**, 9–21 (*Jan.–Feb.*, 1950).

The density difference produced in a radiograph by a difference of section thickness depends on the degree of absorption of the radiation, the contrast of the film at the density level employed, and the magnitude of the difference of section. Since the absorption of the radiation varies with kilovoltage and the contrast of the film varies with the photographic density there is a reciprocal relation between the kilovoltage and the density of the radiograph. The form of this relation and its effect on the exposure time is examined for several different X-ray films for Al and mild steel. Graphical methods for relating kilovoltage to density for a required radiographic contrast and sensitivity are described. A.

778.33 : 539.166

4589. Radiography with cobalt-60. A. MORRISON. *Nucleonics*, **5**, 19–32 (*Dec.*, 1949).

The requirements of γ-ray sources, to replace Ra in the radiography of steel castings, etc., are outlined. These requirements are, high specific activity of penetrating γ-radiation and total activity equivalent to, from 0·5 to 3 g of Ra. 5·3 yr Co^{60}, which emits 2 γ-rays (1·17 and 1·33 MeV) in cascade, is a suitable radioactive isotope. Sources of this isotope, prepared by pile irradiation of Co^{59} have been prepared with specific activities $\equiv$ 10 mg of Ra per mm^3. Graphs are given for various photographic films plotting the exposure factors ([mg of Ra equivalent $\times$ min of exposure]/[source-to-film distance]^2) required to give certain densities, as a function of thickness of steel penetrated. L. R. SHEPHERD

778.

4590. Objectives and methods of density measure ment in sensitometry of color films. F. C. WILLIAMS *J. Opt. Soc. Amer.*, **40**, 104–12 (*Feb.*, 1950).

778.

4591. Color correction with colored couplers. W. T. HANSON, JR. *J. Opt. Soc. Amer.*, **40**, 166–7 (*March*, 1950).

778.83 : 537.53

4592. The focussing X-ray tube. O. E. BERG *Non-Destr. Test.*, **8**, 12–14 (*Fall*, 1949).

Electron focusing in the Siefert (German) tube to 0·3 mm focal spot allows magnification in radio graphs up to 15 times. Tests with conventiona radiography followed by optical magnification shov that the technique with this tube is superior.

F. T. FARME

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